THE

ELECTRICAL REVIEW.

VOL. LXIV. MAY 7, 1909. No. 1,641.

ELECTRICAL REVIEW.

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THE

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(J. A. BERLY'S).

1909 EDITION

H. ALABASTER, GATEHOUSE & CO.,

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THE TRADE BOARDS BILL.

LAST week the second reading of this Government Bill, to which we referred in our leading article on April 9th, was passed without a division, after a discussion lasting over four hours. Almost all the speakers were in favour of giving the Bill its second reading, though many of them stated that, whilst agreeing with the principle of the Bill, they were of opinion that it would require considerable alteration in Committee; more especially with regard to making provision for the protection of a scheduled trade against the competition of foreign sweated labour, and for limiting the power of the Board of Trade to extend the Bill to other industries than those included in the schedule laid before Parliament.

In connection with the question of foreign competition, an amendment was proposed by Mr. Marks as follows:—"That, in the opinion of this House, no legislation can be effective to secure fair wages for workers in this country which does not prevent foreigners who work at lower wages from sending the product of their cheaper labour here in competition with them." In the course of his speech Mr. Marks cited figures to show that, in the four trades affected by the Bill, the rates of wages in France and Belgium were lower even than those paid in this country; and he argued from this that the sweated wages in England were influenced by the still lower wages abroad, and that if they forced employers in these trades to pay higher wages in England, it would lead to their getting the labour on their products performed on the Continent. Mr. Balfour, speaking on this subject, said that he entirely sympathised with the objects which Mr. Marks had in view in proposing his amendment, but as he thought the Bill should be read a second time, he appealed to him to withdraw it, and to deal with the matter in Committee; and later in the evening the amendment was withdrawn.

There appear, however, to be only two ways of satisfactorily dealing with this question of foreign competition; the one being to exclude from the operations of the Bill any industry in which it is shown that foreign competition exists by virtue of a rate of wages paid abroad which is lower than the rate which it is proposed to fix in this country; and the other to protect the industry in question by imposing an import duty on the foreign product. This latter method is not likely to meet with the approval of the present Government, and the alternative of excluding the industry from the operation of the Bill appears to us equivalent to its rejection, if Mr. Marks is correct in his statement that in the four scheduled trades the wages paid in France and Belgium are lower than those paid at the present time in this country. If, as is likely, neither of these methods can be accepted by the Government, there is still a way of partially meeting the difficulty, and we should be glad to see some sign of the willingness of the Government to adopt it; and that is, that an undertaking should be given that

no order for the products of these industries should be placed abroad by the Government or any public body which is spending the taxpayers' or the ratepayers' money.

The strongest opposition to the Bill came from Sir F. Banbury, who thought that the passing of the Bill would open up a fresh market to our foreign competitors, and that, within a few years of its passing, Parliament would be asked to extend the measure to all industries, whether they were protected by Trade Unions or not. He argued that what the Trade Unions had really been contending for was that the State should fix a minimum wage, and prophesied that at every election demands would be made for the Bill to be extended, and that the man who would be elected a member of Parliament would be the one who would give the greatest prize to the electors. That this is a real danger will be recognised by all our readers who studied the Report of the Committee on the Fair Wages Clause, as they will remember that a determined effort was then made by the Trade Unions to get the Trade Union rates of wages recognised by the Government as the minimum rates that could be accepted under the Fair Wages Clause.

The whole question of the fixing of a legal minimum rate of wages is very complicated, owing to the number of conflicting interests that have to be taken into account; and we trust that ample time will be allowed in Committee for the full consideration of the Bill in all its details, as, if it is rushed through without a full and careful discussion, there is great danger of its failing to help the low-paid worker in whose interest it has been introduced.

The Electrical Trades Benevolent Institution.

THE annual meeting of this Institution was held last Friday at the Hotel Cecil. The entire attendance, including the chairman and secretary, was roughly a baker's dozen, but apart from Press representatives, who formed the majority, the gentlemen representing firms actually engaged in electrical trade could be counted on the fingers of one hand. If we were to say that those who ought to have been there were prevented by pressure of business, we might in these days be subject to correction; if we were to charge the electrical industry with apathy, we should perhaps not be as fair as we desire, after the comparative success of the recent festival dinner. Yet we believe that in each of these there is a modicum of truth, while we are afraid that the "aloofness" which up to the present has characterised the action of many important firms and men in the industry, is more largely to blame than either. Not that there is, to our mind, any lack of benevolent feeling, or ability to show proof of that very excellent quality, in those connected with the electrical trades. The "aloofness" may be due to other causes, and we will hope that in course of time it may die out as the *personnel* and objects of the Institution become better known.

That everybody was pleased to see Sir William Preece back again after his indisposition, goes without saying, for of all men in the electrical profession, Sir William is to the benevolent manner born. In case any of our readers do not know it, we ought to mention that the late engineer-in-chief to the Post Office has now completed his 57th year in connection with electrical science and application, and in three years, if he be spared, he will celebrate his golden jubilee. It is gratifying to learn that Sir William is now experiencing "just the feeling of an old dog who knows he has a good long life before him." The recent festival dinner did not come up to his expectations, of course, but a start had been made, and he hoped that in successive years the satisfactory social and musical aspect of the occasion would remain, while the unsatisfactory items of attendance and money subscribed would be improved. The cause of the paucity of subscriptions and the comparative lack of practical interest was considered to be the depression through which we were passing; like every other industry, the electrical was subject to periodic changes, joyous success alternating with depression and failure. Among other causes of this depression, Sir William mentioned that, at the present moment, it was impossible to get money for any new electrical scheme. As evidence of this, he instanced a company of which he was a director, which a short time ago required a large loan. He and his co-directors were informed that if they asked for £100,000 for Canada, for New Zealand, or for any Colony, they would have no difficulty in obtaining it; but if for a home industry, they would have "to pay through the nose terribly." They had to have recourse to this painful experience! The sooner money is freely available for the purpose of home electrical enterprise, the sooner will the industry revive. Let it be soon!

Observations were made by Sir William, and by others, on the important question of whom the fund should benefit, and whether it should be on a contributory basis or not. The Rules of the Institution contain something on these points, and already we have referred to them. It has, however, been decided that the Committee shall, after discussion, draw up a definition saying who will be eligible beneficiaries, and doubtless later we may be able to publish this for the enlightenment of some who may be anxious to know before becoming subscribers. It will be as well to have the point cleared up as far as that is possible. The idea of last Friday's meeting was that the simplest course to pursue in drafting such definitions would be to show who should be *excluded*.

The report of the secretary and some other matters discussed at the meeting are mentioned on another page of this issue. It will be observed that a number of additions have been made to the Committee, additions which, in the main, we believe, will be found to make for strength. Everybody should be satisfied with any widening of the door in making the Institution management representative of the industry as a whole. No one recognises more than we do ourselves, that but for the National Electrical Manufacturers' Association there would be no Benevolent Institution, but it would be a pity if it came to be generally thought that the Institution is a branch of that Association. Mr. Davenport, as we recently reported, has severed his connection with the Manufacturers' Association, and is acting as secretary of the Fund, and the meeting of last Friday decided—we think very wisely—that the honorary solicitor of the Fund should be a gentleman who, if occasion arose, could consider matters relating to the Institution purely on their own merits. It is our firm belief that the more the Benevolent Institution can stand alone, apart from any existing associations or organisations, the more likely is it to meet with a wide acceptance and generous support from those who have it in their power to assist it financially.

Electrical Contractors and Theatre Installations.

THE technical aspect of electrical equipment is very much bound up with commercial considerations. Our attention has been drawn to a phase of this matter which requires investigation. The lot of the electrical contractor is not a particularly easy one, and, moreover, he is to a large extent debarred from making public reference to his difficulties, inasmuch as he stands to be shot at by a variety of interests, any one of which might do him a considerable amount of harm in his business. He has to cultivate friendly relations with the architect who designs a building, the builder who constructs it, and the man who pays for the work. Since it very often occurs that the size of the electric contracting firm, relatively to

that of the other parties engaged in the building of important works, is small, the electrician is oft-times forced to accept conditions which are neither fair nor give any opportunity for conducting business on open lines.

A case in point has recently come to our notice which is, perhaps, more typical of the evil we refer to than is pleasant to think about. An important theatre was about to be erected, and a certain firm of contracting electricians made inquiry of the architect as to whether they could tender for the work. The architect went into the matter with them and fully approved of the general scheme of electrical installation they proposed, and was satisfied with the guarantees they gave as to the quality of the work and materials proposed. Unfortunately, however, the firm some time after received a request from the architect that they should call for a personal interview; it was then explained to them that another electrical firm had agreed to certain special conditions, and that before closing the matter it was necessary to ascertain if they would also undertake the work under those terms. These were, that, instead of a straight figure, let us say, £800 (this was not the actual figure) being paid for the work according to estimate, the electricians should take a price of £1,000, of which £300 should be payable in ordinary shares of the theatre syndicate. On the firm demurring to this arrangement, it was stated pretty frankly that this was a fairly common practice in theatre building, as it enabled directors of such concerns to show a not very excessive capital outlay, and also to be able to state, in appealing to the public, that a certain proportion of the shares had already been taken up. The offer was declined.

We do not venture to endorse the statement of the architect that such a practice is anything like universal in theatre building, as such an indictment would cast a very grave aspersion, not only on a very large body of financiers who are engaged in a usually remunerative form of enterprise, but also on professional men and contractors who lend themselves to such practice. We would, however, point out the fact that it is not an uncommon procedure in the case of theatrical property to raise a mortgage on the building, and also subsequently to float debenture shares in the concern. It is, therefore, difficult to see what real inducement is offered to electrical contractors to take up the equipment of theatres on such terms, inasmuch as they have no real security, and are very unlikely to see a fair return on the capital they have put in it, after the debenture-holders are satisfied. Added to this, there is the evil that the investing public is virtually getting a less return for money than if a fair price had been paid for the work in the first instance.

Unfortunately, there is grave suspicion that theatre-building is not the only form of enterprise which is being conducted at the expense of contractors engaged therein, and we suggest that the matter is quite sufficiently important to engage the serious attention of the various Contractors' Associations.

Extreme-High-Tension Apparatus.

The continual advances made by electrical engineers in the United States towards the use of higher pressures inevitably bring in their train changes in the apparatus and methods employed, and the installation of this kind of apparatus out-of-doors, which has for some time been tentatively adopted, was discussed in a paper read by Mr. K. C. Randall before the Am.I.E.E. last month. According to the *Electrical World*, N.Y., the author stated that transformers rated as high as 500 K.V.A., and built for 60,000 volts, were in use. Attention was necessary to joints in transformer cases, deep overhanging eaves and carefully sealed outlets going far towards rendering the cases weather-proof, while non-freezing oil was required. The high-tension transformer was treated as part of the line, all switching being done on the L.T. side; aerial switches were provided to disconnect the transformers only in case of need. This system has the great advantages of reduced outlay on buildings and diminished risk of fire; the switchgear problem at these high voltages is an exceedingly difficult one to solve under cover, especially when large powers are being dealt with. The fact that such expedients are called for in the United States serves to show strikingly how practice there and here must diverge, owing to the essentially different local circumstances. Here we have no use for any pressure above, say, 30,000 volts, and there appears to us to be no likelihood of higher pressures being called for, though prophecy in electrical matters is very dangerous. The principal disadvantage of the system mentioned appears to be the exposure of the apparatus to the weather during inspection or repair, and this would necessitate special provision to enable the elements to be excluded at such times.

Mr. A. B. Reynders on the same occasion read a paper on the construction of the condenser type of bushing, to which we have previously referred. This consists of an insulating bushing for the terminals of transformers, &c., built up of concentric layers of insulating material and tinfoil. The "theory" is that the latter divides the mass into numerous small condensers, between which the impressed E.M.F. is divided in inverse proportion to the capacities of the various condensers. In spite of the fact that claims were put forward for the superiority of such bushings, we remain entirely sceptical as to their virtues. It must be admitted that the stress on the dielectric nearest the conductor is the greatest, and Mr. O'Gorman and Dr. A. Russell have ably discussed the bearing of this on cable design; but how the application of metallic layers on equipotential surfaces can possibly serve a useful purpose we fail to see. The only effect, as pointed out at the meeting, is to put all the faulty portions of the insulation in series, instead of leaving them isolated from one another.

Chair!

Included in the Standing Orders of the I.E.E. there is a highly salutary rule to the effect that a speaker discussing a paper shall confine his remarks to a period of 10 minutes. While this regulation sometimes presses hardly on members who feel that they have a great deal of useful information to impart, it works on the whole very well, and certainly tends to increase the interest and value of the discussions. Our experience of British engineering meetings has impressed us with the belief that the Englishman generally suffers either from an excess of reserve or from a tendency to verbosity, and of these the latter is by far the least enviable quality; moreover, it abounds especially in the London engineering institutions, which are notorious for the monopoly of opportunity of speaking by the great men of the profession. Hence the value of the rule.

Unfortunately, it has frequently been found a difficult and delicate task to enforce this rule. A conspicuous instance of this was observed during the discussion on Mr. Rider's paper, of which we print a summary to-day. In spite of repeated broad hints from the chairman—the President himself—one speaker held the floor long after his due term had expired, practically defying the authority of the chair. We sympathise with the chairman; the conduct of the offender carries its own condemnation.

Another speaker volubly delivered a lecturette on a point of theory which might have proved of value in a class-room, but was unquestionably out of place in the presence of a body of professional men. True, a considerable proportion of the audience consists of students, but these should be taught the elements of their science at the proper time and place. The time of the Institution is too restricted and valuable to be wasted in this way; and as it was, a large number of members who wished to speak, and whom the audience would have been glad to hear, were compelled to reserve their remarks for obscure interment in the *Journal*.

THE STARTING OF HIGH-PRESSURE INDUCTION MOTORS.

By G. L. ADDENBROOKE.

The debate on Mr. Rider's paper raised a very interesting side issue on the behaviour of high-pressure induction motors, and the breakdowns which have occurred in them when the high pressure is switched on. Having had an experience of this character in my own work, I have been led to pay some attention to the question, and as I do not think that any of the explanations given by different speakers on the paper were entirely satisfactory, I venture to put forward the following alternative.

In the first place, I was glad to find from Mr. Rider's paper that the effect was not due to resonance. Resonance is a convenient cause to which we are getting rather accustomed to assign any unexpected effects which occur and which are not easily explicable by other means. In the case in point, the manufacturers of the motor at once put down the effect to resonance, but its primary cause was proved to be the winding of the stator coils in the same way as the coils which Mr. Rider had to condemn. Nevertheless, it does appear that there is some rise of voltage in starting which is worthy of attention and which should be accounted for.

It seems to me that the following is probably the explanation. These induction motors are practically always started with slip rings and a water resistance, and the careful attendant is always sure to open the water resistance pretty well to its full extent to reduce the starting current as much as possible. Under these circumstances, the water offers a very high resistance, and the current which can flow in the rotor is, until the resistance has been closed to a considerable extent, very small. Moreover, any effect which occurs at starting probably takes place before the rotor has started moving, so that we can really regard the whole machine when starting as a transformer, but a transformer on open circuit, with an air-gap in the iron circuit and considerable magnetic leakage through the air.

We must also, I think, take it that there is little polarisation of the iron at starting, such as there is often with a closed-circuit transformer.

If, now, the current is suddenly switched on while the impressed voltage is considerable, there will be no collapsing lines of force already stored in the iron to partially balance it, and a rush of current takes place; the iron will be magnetised to, say, twice the normal intensity to create sufficient back E.M.F., and a corresponding amount of energy will be stored up in it. When the impressed voltage diminishes and reverses this extra amount of energy must be given back to the circuit, and owing to the fact that there is an air-gap, some part of this energy tends to be liberated very suddenly; in fact, there is something of an induction-coil effect. It may be also that the first slight motion of the rotor altering the relation of the slots in the iron of the rotor to those on the stator helps to set free suddenly some of the energy stored in the iron. This return flow of energy will be damped back by the self-induction of the machine and circuit for the most part, but these motors having such an appreciable capacity, the rapid liberation of energy is facilitated, and finds an outlet in the capacity of the machine, which capacity becomes charged much above the normal pressure of the circuit for a very brief period—brief in proportion to the time of an alternation. The coils act as a row of condensers in cascade, the outer coils getting the highest charge. The action is probably so rapid that the self-induction of the main circuit, and perhaps the first few turns of the first coil, is sufficient to prevent appreciable relief by flow of current though the main circuit until the back pressure has mounted up considerably. The capacity allows enough energy to accumulate to cause a spark possibly over the surface of the insulation at the ends of the micanite tubes, which is sufficient to damage the insulation of the end coils, but usually without breaking it down altogether, as the extra E.M.F. is quickly dissipated. After the first alternation the iron rapidly gets into swing with the flow of current and the effect is reduced.

This explanation, whether correct in all details or not, accounts for the heavy current at starting, noted by Mr. Sayers; for the spark to earth, noted by Mr. Jenkins, which was not seen on the oscillograph, and for the fact that the damage seems to be caused by a condenser discharge, since, in the writer's experience, the action appeared only sufficient to slightly damage the insulation.

The breakdown was not usually immediate on starting the machine. Some action appeared to take place then which weakened the insulation, and caused a particular turn in a coil to more or less short-circuit and the whole coil to run hot, and then after the machine had been in use sufficient time to heat this coil its insulation gave way altogether.

To remedy this, obviously the first thing to do is to wind the end coils as suggested in Mr. Rider's paper. The next is to provide some means of preventing the occasional heavy rush of current at starting and the extra magnetic action on the iron which it causes.

This can, it is true, be effected by the use of inductive resistances, and the use of a properly proportioned condenser across the terminals of the machine would also probably be effective; but these seem more complicated and expensive devices than the use of water resistances in the high-pressure circuit, which will only allow a very small current to flow when the oil switch in the main circuit is closed, and thus will give the iron time to get into swing with the alternations of the current as this resistance is gradually cut out, and prevent excessive magnetisation with its correspondingly high back E.M.F.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Darlington Turbine Tenders.

My attention has been called to a paragraph in your last issue giving a list of tenders and other particulars concerning a contract about to be entered into by the Darlington Corporation, although the tenders for this plant are still under consideration.

It is not the practice of this Corporation to publish the amounts of tenders received, and I am surprised to find a leading technical journal publishing matter which has been obtained in an irregular manner, and which is consequently liable to be inaccurate and misleading.

As the list of tenders and other information contained in the paragraph referred to above are not correct, and are likely to mislead the manufacturers concerned, I shall be much obliged if you will insert my letter in your next issue.

Thanking you in anticipation,

J. R. P. Lunn.

Darlington Electricity Department,
April 27th, 1909.

[We hardly need say that our information was obtained in a manner not in the least irregular, and so far as we can learn it was not inaccurate.—Eds. E.R.]

Mercury Motor Meters.

Surely the letter of "Strebor" is unworthy of a place in a technical paper. If your correspondent knew elementary electricity and magnetism, he would appreciate that, with an equal current in both tests, the potential between the meter's two terminals must also be equal. Perhaps he will next suggest that when current is taken from a battery it is saturated with acid.

However, I can assure "Strebor" that it is rather late in the day to criticise mercury motor-meters, since the premier firm of commutator-meter makers have commenced making or selling the mercury type. Recently a large German firm intimated by advertisement for men that they were commencing to make mercury meters, indicating that German users are not quite satisfied with the out-of-date commutator, heavy armature and high speed.

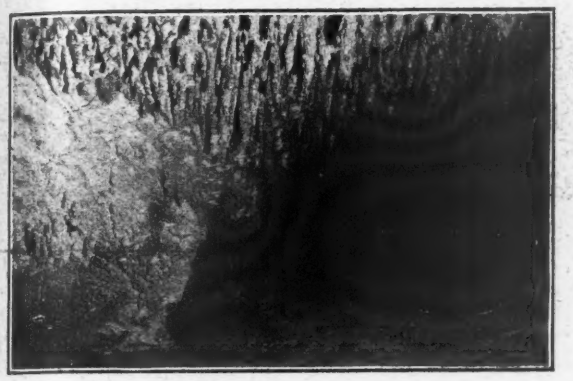
My principals guarantee the first five sizes—1½, 3, 5, 10 and 25 amperes—to start and continue recording with 0·05 ampere, and accuracy is guaranteed to one-twentieth of the capacity of the meter.

R. H. Schofield.

Hollinwood, *April 27th*, 1909.

Interior of a Destructor Furnace.

I beg to enclose a photograph of one of our Stoke destructor furnaces when let down for cleaning. About six weeks' firing produces the effect shown. The destructor is



Interior of Furnace.

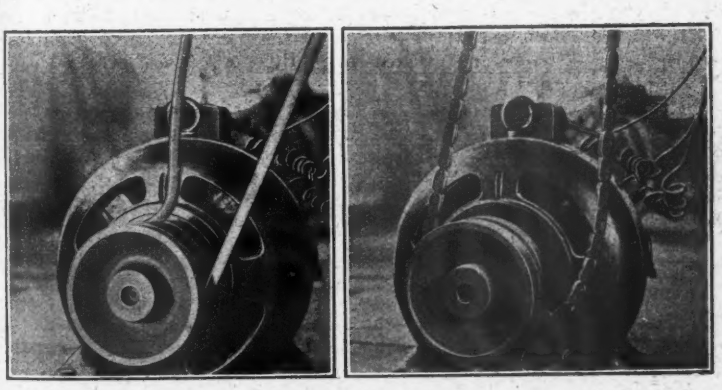
a Meldrum; the three openings to the doors can be seen on the left, and the fire bars can be distinguished at the bottom of the photograph.

P. J. S. Tiddeman.

Electricity Works, Stoke-upon-Trent,
April 29th, 1909.

A Good Belt Drive.

I enclose two photos of a belt drive which may be of interest in view of the extraordinary curves taken by the slack side of the belt when running. The belt is a Whittle leather V link, ⅝-in. size, and is running on the pulley of a 5-H.P. electric motor at 1,000 R.P.M.; the pulley diam. is



Link Belt, Running and at Rest.

12 in. The pulley groove where the belt runs is comparatively dull, showing that friction and slip are very small; the users inform me that the belt has been in use four years, without being touched in any way.

Photo No. 1 shows belt running; direction clockwise.

Photo No. 2, belt at rest, giving an idea of the slackness.

F. V. L. Mathias,
Borough Electrical and Tramways Engineer.

Warrington, *April 29th*, 1909.

[To our mind, it is not so much the curve when running as the remarkable slackness of this belt for a vertical drive that calls for notice.—Eds. E.R.]

The Expansion of German Trade.

With reference to the letter from "Consultant" regarding the "Anti-Bunkum" communication to the *Westminster Gazette*, I think that the directors of the German firm referred to should be very grateful to the author of the latter letter for the good advertisement given. It seems a pity that the subject of politics has been brought into the question, but it is certainly amusing to find the expansion of German trade used as an argument *against* Tariff Reform. I should be glad to know who are the best authorities in Germany that estimate the extra cost of exported material to be 5 per cent. due to import tariffs on semi-manufactured goods. What semi-manufactured goods are used for the manufacture of electrical machinery in Germany other than cast-iron? and including the copper, sheet-iron, forgings, steel castings and other parts, can "Anti-Bunkum" show that out of an export price of about £70 to £100 a ton more than a few shillings have been spent on import duty?

Further, how has it been possible for a manufacturing concern, groaning under the yoke of a reactionary tariff system, and built up by means of a financial system classed as unsound by the average Free Trade banker, to build up the reserves in cash and securities as alleged? If the German protectionist system is unsound, why is it easier for a German manufacturer to raise money in Berlin than it is for his British competitor, in the so-called money market of the world? It is interesting to note that a Free Trader can appreciate the assistance of the Government in industrial operations by means of Consular efforts, railway export rebates, and shipping subsidies, operations directly opposed to the principles of Cobden.

The big industries in Germany have been built up largely by the Industrial Banks, based on the security given to the trade by protective tariffs, and this fact will be admitted by almost any German business man *in Germany*, when carefully questioned on the matter, but, naturally, they will not admit this over here. Apart from the question of tariff, a German, like any other man on the Continent, will not buy foreign machinery if he can possibly obtain what he wants from his own country.

The writer touches on the old question of consulting engineers' commissions, a complaint usually made by Germans and Americans. It is a well-known fact that when contractors take a large proportion of their payments in shares or debentures, and no consulting engineers are appointed or are retained in a nominal capacity for appearances' sake, then the price paid to the contractor far exceeds 5 per cent. above the market value of the plant. As far as commissions are concerned, there is more bribery in business on the Continent than in England.

The concluding paragraphs in "Anti-Bunkum's" letter contain the most important questions. Thanks to the present-day system of banking and industrial finance in this country, the manufacturer knows by bitter experience that it is a waste of money and useless to send out engineers and agents to places abroad to obtain concessions, or business on the "payment by result" system, when he cannot raise the money to carry out the work except through professional company promoters or irresponsible financiers at exorbitant rates.

Given open contracts, cash payments, and fair play, the manufacturers of heavy machinery in Great Britain are prepared to face competition from any country, despite statements to the contrary by interested parties, and when bankers and financiers are prepared to co-operate with the manufacturer in a similar manner to that done on the Continent, home firms will be as eager to obtain concessions as their German and American competitors.

At present only about £5 is invested in British industrials for each £100 sent out of the country, in the year, and this is due to Free Trade and the absence of industrial banks.

If one quarter of those people who go out of their way to run down the British manufacturer, and beland the foreigner,

would spend an equal time in trying to assist home industries, matters in this country would be much better than they are at present.

Theodore Rich.

London, S.W.

Testing Live Cables.

In reply to Mr. Stuart A. Russell's remarks in the "Correspondence" columns of your issue, April 23rd, 1909, I regret to state, after examination of my paper on the "Testing of Live Cables," of which an abstract was published in your paper a few weeks back, that he is quite correct as to the error he points out. I wish also to inform your readers that the vital part of my paper is affected by this error. Thanking Mr. Russell for his kindness in finding out this regrettable error.

R. G. Allen.

Dublin, *April 30th*, 1909.

The Engineer and the People.

Your correspondent, Mr. Horace Boot, has hit the right nail on the head in saying that it should be made impossible for a man to set up in practice or call himself a consulting engineer unless he has had the requisite training. This, however, raises the question "What is the requisite training?"

The Institution of Civil Engineers, which is recognised all the world over as the premier engineering Institution, has for years been considering this and other questions relating to the elevation of the status of professional engineers, and has recognised that a first-rate technical training and an apprenticeship either in works or in an engineer's office are essential. The Institution is also considering means of suppressing unprofessional conduct on the part of its members.

Your correspondent urges that the Institution of Electrical Engineers should take some such steps to discriminate between the mechanic and the highly-trained engineer. I quite agree that this would be an excellent plan, but for the sake of the general public, may I be permitted to state that the Institution of Civil Engineers admits electrical and mechanical engineers, the word civil being used in its broadest sense—*i.e.*, civil, as apart from military or naval engineers.

The Institution of Electrical Engineers is without doubt behindhand in this matter, but since the Institution of Civil Engineers opens its doors readily to the highly-trained engineer, whether he be mechanical or electrical, or "civil," I do not see that it is essential for the lesser Institution, which consists of the one branch only, to upset itself for the convenience of those who would be able to prove their status to the general public, and to their own satisfaction by joining the greater Institution, which has already benefited the profession to so great an extent, and is still striving to elevate the status and morals of the professional engineer—civil, electrical and mechanical.

An Electrical Engineer.

April 28th, 1909.

London's Electricity Supply.

On looking up Messrs. J. H. B. and F. T.'s article on "Bulk Supply," I find that it appears to be virtually in agreement with my suggestions. However, the passing of the London Electric Supply Bill, 1908, fully justified further consideration of the subject, and I am pleased to see that these gentlemen have looked further into the matter, for their opinion should be very valuable, in view of the fact that they have made a special study of the subject.

"Linking up" can hardly be described as a new phase of the bulk supply problem, nor is it contended that it would be a solution of the same. It provides for co-operation or giving and taking of supply, which is quite a different subject to bulk supply, and it should effect a result which bulk supply alone could never hope to do.

It is a moot point as to whether bulk supply would ever pay in London, but we should look at the case broadly, and arrange interconnections on proper lines, instead of haphazard, so that they would form an integral part of the bulk supply system, if it were ever adopted, for otherwise the ultimate purchasing body would have to bear the cost of the necessary alterations; therefore, what we require is some incentive to adopt a standard system, although it might not be necessary to meet present requirements.

I notice the reference to "uneconomical or principally lighting stations," but I would suggest the word *apparently* before uneconomical. The economy in some power stations is not entirely due to their fortunate geographical location for cheap production, but to a great extent to their good daily load factor. It will be found that some of the lighting stations, which are apparently uneconomical, produce energy during the period of heavy load, quite as cheaply as the power station; therefore we have only the period of light loads to consider, and by co-operation of the lighting stations, the energy could be produced during that period economically.

Turning to the points in my article with which Messrs. J. H. B. and F. T. disagree—

1. "The maximum loads at the various stations occur approximately at the same time."

This statement appears to have been misunderstood; I was speaking generally of the period of heavy load of the whole of the London stations, not individual ones.

It is a fact that the greater portion of the demand at the period of heavy load on the London station is given for lighting purposes, and, therefore, the maximum demand must naturally occur somewhat about the same time, but, of course, if you bring industry into an isolated case, the heavy load period must be moved, more and more towards the period when work is at its maximum, according to the preponderance of the power demand over the lighting or overlapping.

What I wished to point out when I made the statement under discussion, was (apart from power stations) that it was doubtful if you could derive any benefit from shutting down lighting stations during the period of heavy load, but that they could mutually benefit by taking turn in supplying the demand during the daytime, &c.

2. The formation of a joint board of control should not be impracticable, for stations already "linked up" have practically such a board, consisting of their respective Councils or boards of directors, and the proposed central board would only be an expansion of the existing system.

What would be the condition of affairs without a joint authority? A and B might link up to suit themselves, and C and D do likewise; and if, at any future time, A should want to link up with D, it might be found to be impossible without expensive alterations, and the joint board would have probably prevented that. However, we are getting back to first principles.

"Axiom 2." *Loans are raised on security.* The board would not be independent, but representative, and could offer the same security for the loans as the existing undertakers, who have interconnected their systems, now offer.

3. It is surely not difficult to agree on a standard system; the difficulty appears to be the provision of the extra cost (if any) entailed by adopting the standard system, as compared with the requirements of the moment, but it is better to look a little way further ahead, for the standard system, although perhaps more costly to install and run, might be the means of extending co-operation at some future time, with additional benefits.

4. Bulk supply stations would be erected, and extensions of present stations cease, of course, only if it were found to be more economical than present methods. Two stations were suggested as it is thought that there is an economical limit to the size of a single station, and the demand in the London area could be better served from two sources of supply. Moreover, the consumer would gladly pay a little more, if necessary, to have the supply rendered more reliable.

Apart from the above, when one bears in mind what trifling accidents have caused the shut down of some of London's largest stations, the wisdom of providing two sources of supply will be apparent.

5. My suggestion was that the financial problem should first be solved, for the overcoming of engineering difficulties without financial success would not be very pleasing to the authorities.

I think that if the financial success of "linking up" or "bulk supply" is assured, we can depend on the eminent members of the engineering profession to evolve a solution of the engineering problem.

In conclusion, I must say I am pleased to see that engineers, whose daily duties in conducting a supply undertaking must fully occupy their time, have gone out of their way to discuss this subject, which is of importance to the majority of London's citizens.

H. F. J. Thompson.

Battersea, *May 3rd*, 1909.

Parallel Running with Earthed Neutrals.

By a, perhaps, not unnatural coincidence, the idea I suggested during the discussion on Mr. Rider's paper on the 22nd ult., viz., to connect the neutral point of each alternator through a choking coil to a common bus-bar which is connected to earth through a resistance, appears to have occurred quite independently to Dr. Sumpner, and I am pleased to note from his letter to you dated the 26th ult., that he considers the idea a sound one.

I entirely agree with Dr. Sumpner that for reducing the current between the neutral points of the machines, the choking coil arrangement is far simpler than the device for connecting only one machine to earth at a time, but I cannot endorse his opinion when he further states that the choking coils should be made large enough to prevent serious earth currents.

I think that the choking coils should be designed to deal with the currents circulating between the neutral points, and that they should not oppose to any very appreciable extent the normal frequency currents going to earth, these being dealt with by the main resistance.

I venture to suggest that both as regards cost and limiting of current to earth, the arrangement of carbon powder resistances which I described at the meeting on the 22nd ult. possesses very considerable advantages over existing methods.

An earthing resistance, if of the ordinary iron grid type (where the ohmic value is lowest when cold), with or without choking coils in series, must be of such a value that when the fault occurs on the longest feeder, sufficient current will pass to trip the automatic switch on that feeder.

Mr. Rider states that in his system the value of the resistance must not be more than 3·5 ohms, and it is, therefore, possible to get 3,700 ÷ 3·5 = 1,050 amperes to earth, if the fault is so close to the station as to make its resistance negligible.

With carbon powder resistances, on the other hand, the ohmic value is highest when cold, and decreases as the resistance heats up.

Taking a resistance which decreases to ⅛th of its original value, at which figure it remains practically constant, it is clear that we can afford to have a resistance which will be five times 3·5 ohms = 17·5 ohms when cold.

The maximum current that will pass to earth when a fault occurs is then 3,700 ÷ 17·5 = 212 amperes. If this is not sufficient to trip the automatic switch, the resistance will automatically decrease until just sufficient current passes to cause the switch to break circuit; and this latter current (250 to 300 amperes) should be the maximum which will pass to earth under any circumstances, assuming that the automatic switches work properly. It is, therefore, clear that with the carbon-powder resistance the greatest current when a fault occurs will be 212 amperes, and the maximum that the automatic switches will have to break will be 300, whereas with ordinary resistances the current in both cases will be anything between 300 and 1,050, and probably will most often be nearer the latter figure.

H. Brazil.

Beckenham, *May 3rd*, 1909.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The "Denny" Combined No-Volt and Overload Release.

An entirely new departure in no-volt and overload release coils, as applied to motor starters, circuit breakers, &c., has been devised and patented by Mr. C. W. Denny, of 67, Cross-Brook Street, Waltham Cross. We illustrate in the accompanying figures a form of coil arranged for use in conjunction with motor starters of the multiple-contact type. The apparatus, which combines the no-volt and overload release features in a single coil, considerably simplifies the connections and cheapens the manufacture.

A further advantage is claimed in that no shunt connections are brought into the starter (in the case of shunt-wound motors); this point is of greater significance when the starter is at a considerable distance from the motor, two connecting wires only being necessary as against three. The coil is adaptable to shunt and series motors alike.

The magnet employed, which is similar in appearance to an ordinary no-volt coil, is fitted with two armatures, or keepers, the one on the left (fig. 1) being the no-volt keeper and the other the overload keeper; the coil when in use being mounted in an inclined position, the no-volt keeper rests on the magnet face, and the overload keeper rests against an adjustable stop away from the magnet face. Passing through a hole in each pole piece is a freely sliding rod or plunger, slightly longer than the pole piece and normally projecting a short distance beyond the overload keeper end of the magnet.

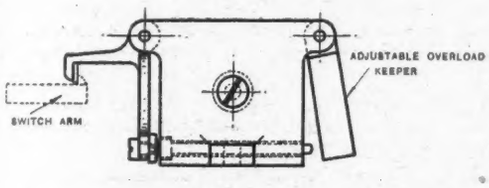


Fig. 1.—End View.

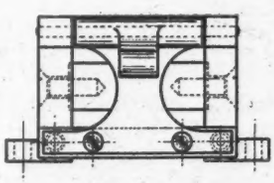


Fig. 2.—Side View.

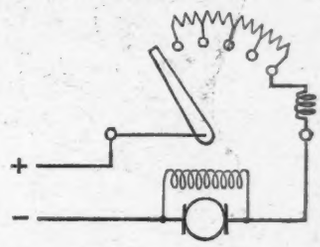


Fig. 3.—Diagram of Connections.

"Denny" Combined No-Volt and Overload Release.

The action of the magnet is as follows:—As soon as the switch arm is brought on to the starter contacts, the main current passes round the coil and energises the magnet. When the switch arm has arrived at the full "on" position it wipes under the catch, which, owing to the no-voltage keeper being attracted and held by the energised magnet, engages with the arm and retains it in its "on" position. Should the current fail or fall below a predetermined value, the magnet will be de-energised; the spring attached to the switch arm, pulling the latter against the catch, will cause the keeper lever to rock upon the fulcrum, allowing the arm to wipe under and release itself from the catch and return to its "off" position.

Should an overload occur (assuming the switch to be in its "on" position), the overload keeper will be attracted towards the magnet face and will strike the projecting lower ends of the loose plungers, which will be forced upwards. This will cause the upper ends to strike the no-voltage keeper (which is against the magnet face) and cause the lever to rock upon the fulcrum, and thus allow the catch to release the switch. By arranging the no-voltage keeper so that it only has to be lightly attracted (by reason of the system of levers) in order to balance a strong pull on the switch lever, it admits of being easily released by the overload keeper coming into action. The no-voltage keeper is very much smaller in section than the overload keeper, so that it does not absorb many of the magnetic lines, and allows a large magnetic leakage from the magnet in the direction of the heavier overload keeper. When the leakage is slightly increased by an excess of current (as above described) the armature is attracted and the magnetic circuit completed.

Should the overload keeper be only attracted very slowly and with insufficient force to cause the plungers or pins to release the no-volt armature, the latter will be released by reason of the fact that when the overload armature or keeper comes in close proximity to the face of the magnet, the magnetic reluctance across the intervening air gap is very much decreased, and a greater portion of the magnetic field passes through the overload keeper, consequently weakening the pull on the no-voltage keeper, which is then tripped or released by the pull of the switch arm on the catch.

In a modification a no-voltage coil only may be employed, being wound and connected up in the ordinary manner. In this case only the no-voltage keeper (with its lever and catch arm) is employed, the overload armature being dispensed with. Owing to

the leverage ratio between the keeper and catch arm, a small pull on the keeper balances a stronger pull of the switch arm on the catch, so that a much smaller coil can be employed than with ordinary no-volt release magnets.

Back Gears for B.T.-H. Motors.

The British Thomson-Houston Co., Ltd., Rugby, have developed a special method of applying back gear to small motors, which requires no alteration to the motor itself, other than fitting a pinion to the shaft and two dowel pins in the feet. The device consists essentially of a strong cast-iron cradle, to the base of which the motor is bolted. Two brackets, one at each end of the cradle, support a bearing housing for the countershaft, and a sheet-iron case to enclose the gear wheels.

The base of the cradle is machined flat above and below, so that the motor can easily be set with its shaft exactly parallel to the countershaft, and the outfit mounted on slide rails when used in connection with a rope or belt drive.

The countershaft bearing housings are made in one piece to ensure accurate alignment, and can be rotated in the cradle brackets to allow of the cradle being fixed in various positions. The motor

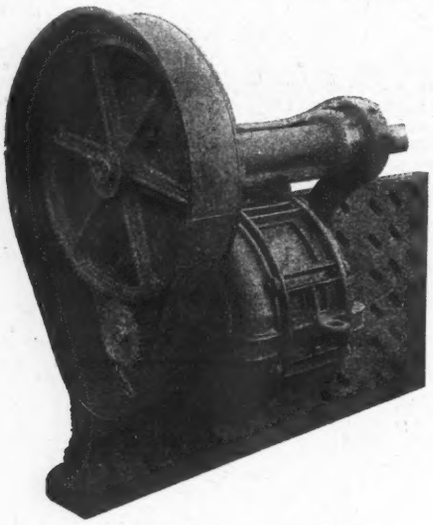


Fig. 4.—B.T.-H. Back-Geared Motor.

end shields can also be rotated, so that the whole can be mounted on floor, ceiling, or wall; in the latter case the motor may be either above or below the countershaft.

Cast-iron bearings of liberal dimensions are provided for the countershaft. They are lubricated by means of oil rings, and fitted with oil overflows and drain plugs.

To ensure smooth working and long life, the teeth on the cast-iron gear wheels and steel pinions are accurately machined. Black fibre packing pieces are interposed between the gear case and the cradle, and these, together with correctly designed and well made gears, reduce the noise to a minimum.

The side of the gear case can readily be removed for inspection of the wheels without disturbing any other part of the equipment. The cradles are made in different sizes, suitable for various B.T.-H. motors, D.C. and A.C.

An Electrical Fog Signal.

We have received from Mr. W. de Ruyter van Steveninck, 56, Chaussée de Haecht, Brussels, particulars of the Mantsch system of fog-signalling, in which a magazine cartridge-holder is employed. The cartridges are provided with platinum wire igniters, and are loaded with black powder primed with gun-cotton; they are inserted in sockets round the periphery of a wheel, which is rotated by a cord and weight. The whole apparatus is mounted in a weather-proof pillar at the side of the track, and a trumpet in front of the cartridge directs the sound of the explosion towards the driver of the locomotive.

The cartridge is fired by a current provided by a small battery when the locomotive, in passing, closes the circuit by means of rail contacts or a treadle; the explosion expels the cartridge backwards from its socket, while the wad is fired out by a curved tube guiding it to the ground. The removal of the cartridge liberates the magazine wheel, which rotates until the next live cartridge comes against a stop, leaving the apparatus all ready for a repetition of the signal. To prevent the expenditure of a cartridge as each vehicle passes the spot, a relay is provided which cuts out the firing circuit until the whole train has passed, when it opens and restores the connections in readiness for the next train. At the same time a bell is rung in the signal box from which the fog-signal is controlled; and if the magazine, which holds when full 50 cartridges, is nearly empty, only five being left, the alarm bell rings continuously and cannot be stopped. If the signalman disregards this warning, the case of the apparatus becomes locked when the last cartridge is expended, and cannot be opened by the signalman. The empty cartridge cases are caught in a box and can be recharged. The use of percussion caps, which are apt to cause misfires, is avoided by the adoption of electric firing, and the fog-signal is readily brought into or out of action by an electric circuit in connection with the manual signals, while fog-men are dispensed with. We are informed that trials made in Belgium with this apparatus have given satisfactory results, and its simplicity is a strong point in its favour.

ELECTRICAL TRADES' BENEVOLENT INSTITUTION.

At the annual meeting held last Friday at the Hotel Cecil, Mr. W. Davenport read the following report of the work done during the year 1908-9:—"The year has been one of considerable activity in different directions. Messrs. Alabaster, Gatehouse & Co., the proprietors of the Electrical Review, signified their willingness to contribute a sum of £50 to the funds if some special form of activity were displayed in the work of the Institution. An immediate response to this offer was not possible due to the Manchester Electrical Exhibition taking place in the autumn of 1908. The Manchester Exhibition having proved successful, a sum of about £350 is coming at an early date to the Institution. It was felt that the announcement of this sum together with others could be most appropriately made at a festival dinner, and a committee was appointed to arrange this function. A special collection, both before and at the festival dinner, was made, resulting in the receipt of over £660, so that the result of the year's working has been to increase the funds of the Institution by over £1,100. The festival dinner, apart from its immediate direct results, was a great success, and may well be regularly repeated in the future. During the year two cases for relief came before the Committee, and both proving deserving ones, were promptly attended to with most satisfactory results. Other cases are now before the Committee for consideration. The invested funds are sufficient to pay one or more pensions, but by the rules no pensions can be allotted before next year. The Committee of Management and the Dinner Committee have been most active in collecting funds, but it is desirable now that the Institution is becoming well known to secure the co-operation of one or more persons in every undertaking to act as collectors for the Institution. The balance-sheet has been sent out with the invitations to attend the meeting. The Institution has had to give up the use of the offices at No. 2, Queen Anne's Gate, Westminster, S.W., kindly loaned free of all charge by Mr. C. S. Northcote, but there is every probability that the Institution of Electrical Engineers will, in its new home on the Thames Embankment, provide accommodation for meetings in connection with this Institution, also free of charge. The executive office remains at Ridler Place, Blackfriars: The committee take this opportunity of thanking Mr. C. S. Northcote for his kindness in providing offices free of charge to March 25th, 1909. The thanks of the Institution are also due to the Press for support on many occasions. Representatives of the Electrical Press have been on the Dinner Committees, and have displayed great activity also in that direction. The funds at present in hand or certain to accrue are:—

Victoria 3½ per cent.	£1,100
Cape of Good Hope 3½ per cent.	600
Electrical Exhibition, 1905 (expectant)	350
Electrical Exhibition, Manchester, 1908 (expectant) ..	350
Cash in hand	64
	£2,464

Thanks were accorded, on the motion of Sir Wm. Preece (chairman), seconded by Mr. W. B. Esson, to Messrs. W. M. Mordey, R. K. Gray and J. H. Rosenthal for their presence at the Festival Dinner.

The following retiring members of the Committee were re-elected on the motion of Messrs. Lundberg and Rentell:—H. H. Berry, H. Bevis, G. Burney, E. J. Clarke and Justus Eck.

To these were then added, on the motion of Sir William, seconded by Mr. Eck:—Sir J. Irving Courtenay, and Messrs. T. E. Gatehouse, J. Wallis-Jones, E. Garcke, W. B. Esson and Skinner. Suggestions as to other names may be forwarded to the secretary.

Messrs. Hextalls, of 21, Bucklersbury, E.C., had offered to undertake the duties of honorary solicitor to the Institution, and after discussion their election was unanimously agreed to.

Mr. Henley Smith was re-elected auditor.

On the motion of Mr. Gatehouse, the meeting accorded its hearty thanks to Sir William for presiding, and, in brief, wished him long life and many of 'em.

Electromobiles in Cleveland, U.S.A.—According to the *Electrical World*, N.Y., out of 4,000 automobiles in use in Cleveland, over 1,000 are electric, and the number of the latter type is rapidly increasing. The mercury rectifier is very largely used for charging the batteries from A.C. mains, the number of private garages thus equipped being estimated at 300; the batteries are charged during the night, with an automatic cut-out to interrupt the circuit when the charge approaches completion. A simple device for varying the resistance in circuit with the cells is a pair of gas pipes covered with asbestos, and over wound with "common fence-wire"; the resistance is controlled by means of a piece of wire with bent ends, which is hooked over the pipes so as to cut out more or less of the resistance wire.

PARLIAMENTARY.

York Town and Blackwater Gas Co. (Electricity) Bill.

On Thursday, April 22nd, a Select Committee of the House of Commons, under the chairmanship of Mr. Rose, commenced the consideration of the above Bill. The opponents were the Easthempstead U.D.C., represented by Mr. Jeeves; and the Aldershot Gas and Water Co., represented by Mr. H. Lloyd, K.C.

Mr. Balfour Browne, K.C., who represented the promoters with Mr. Vesey Knox, said the Bill sought to extend the limits of the company's area of supply; to enable them to supply electricity, and to change the name of the company. There was another Bill before the Committee promoted by the Aldershot Gas and Water Co., who also sought to extend their area and supply electricity. His clients were seeking to repeal certain powers of the Aldershot Co. over an area which they had never supplied, and which, as a matter of fact, his company were now supplying. They also sought to supply electricity in the districts of Frimley, Sandhurst, Crowthorne, Finchampstead and Wokingham, and parts of certain other parishes. They wished also to repeal the powers of the Camberley Electric Supply Co., which had never supplied electricity in the area covered by their gas supply. To carry out these powers, they also asked sanction to raise £50,000 additional capital, and to borrow £16,666. Counsel proceeded to trace the history of the company, which was incorporated in 1859, and had since 1893 supplied the War Office with gas in bulk, for the illumination of Sandhurst Military College and other Government buildings in the area. In 1904 the company obtained an Act which enabled them to apply to the Board of Trade for a provisional order to supply electricity, but in the same year the Camberley Electric Supply Co. was registered with a capital of £1,000. That company had done nothing. They had obtained the last report from Somerset House, and found the significant sentence:—"The company has no assets or liabilities, and no auditors have been appointed." The fact was that the Camberley Co. could do nothing, for this district, although it would use a certain amount of electricity, would never be supplied with electricity unless it was done by a gas company which had lands and a staff which could be utilised partly for such a purpose. In 1905 his clients applied to the Frimley Urban District Council for their consent to supply electricity, but it was refused. Now the local authority were not opposing the Bill, but his clients had agreed that if they got powers to supply electricity they would not exercise them for 12 months, to allow of the District Council making up their minds whether they would themselves apply for a provisional order. The Easthempstead District Council thought they ought to have proceeded by provisional order; but they had no alternative but to proceed by Bill, if they wished to spend capital on an electricity undertaking. They had a sliding scale with regard to gas, and if their profits were reduced it would mean a loss of dividends.

Mr. Jeeves: And our price for gas would go up.

Mr. Browne said that was so, and therefore it was not likely they would go into the business unless they thought it would pay.

Counsel then called evidence in support of the scheme.

Mr. S. Sellon, M.I.C.E., speaking of the proposals now before the Committee, said he did not consider they could be sound or feasible unless coupled with the arrangement which the promoters suggested—namely, associating the scheme with a gas undertaking. In his opinion it meant all the difference between profit and loss. He was not surprised that the Camberley Co., who had got powers to supply in the area, had not been able to do anything. He knew the district over which the company wanted to supply, and he thought there was room for such an undertaking as was proposed. He thought the promoters could look for large consumers of electricity, such as the Royal Military College, Staff College, Wellington and Broadmoor Asylum. The estimate which he had made included the laying of mains—3½ miles in Crowthorne; York Town and Camberley, 6 miles; Hawley, ½ mile; and Sandhurst, 3½ miles. He estimated that the cost of laying down the mains, together with the necessary generating plant, buildings, &c., service mains and meters, would be £25,000. That would allow for a capacity of 144,000 units. Nowadays an estimate was formed on the amount of electricity which might be taken *per capita*, and he thought that 12½ units per head would be taken. Reckoning that amount of energy to be consumed at a cost of 4½d. per unit, it would give them a gross profit of £2,343 per year. The price of 4½d. per unit was not their maximum charge—it was 7d. and 8d. in Aldershot. The promoters were in a better position than a company just starting, for they had joint ownership of land, joint supervision, a collecting staff, the use of energy supplied from producers which were fed entirely by gas coke, and a joint organisation for meter inspection and the collection of accounts. All those conditions tended to economy, and he considered that it would mean something like 1d. per unit on the output. He estimated that with the combined scheme there would be a net profit of £1,468, but they would only get £835 if the scheme was not dependent upon the gas side of the business.

Cross-examined by Mr. Hutchinson, for the Aldershot Co., Witness said that his experience, in similar instances to that which was now under consideration, was that it was better for the supply of the two illuminants to be in one hand. Capital could be more easily raised where the investor knew that there was a gas revenue on which the electrical part of the undertaking could fall back. In the case of the Camberley Co., that was a scheme purely for the supply of electricity, and, as they were aware, nothing had been done. They proposed to have an alternating-current system, with a pressure of 6,000 volts capable of being transformed down to 200 volts. He was aware that if the promoters got into the Frimley area under the Bill by reason of the electricity clauses, they could also compete with the Aldershot Co. for the gas supply. He was not aware that the Frimley U.D.C. had offered to the Aldershot Co. the right of entry into that area.

Replying to Mr. Jeeves, for the Easthempstead R.D.C., Mr. Sellon said that the length of line in that district was three-quarters of a mile. He knew of no precedent where Parliament had allowed an undertaking to enter an area in the face of opposition from the local authority. There was no provision in the Bill for a supply to Crowthorne on practical terms, unless the company chose to give a supply.

Further evidence having been called, the Committee decided to reserve their decision until they had heard the Aldershot Gas Co.'s Bill.

After hearing the Aldershot Gas and Water Co.'s Bill, the Select Committee passed the preamble of the York Town Bill, which will authorise the company to supply electricity. The Committee, however, decided to confine the company's operations to its present gas area.

Aldershot Gas and Water Bill.—The Select Committee which considered the York Town and Blackwater Gas Co. (Electricity) Bill afterwards proceeded to hear the Bill promoted by the Aldershot Gas and Water Co., which seeks to authorise the company to produce and supply electricity within their area of supply. After hearing evidence, the Committee passed the preamble of the Bill.

Anglo-Argentine Tramways.—This Bill came before the Unopposed Committee of the House of Commons on Thursday last week, and formal evidence having been given in proof of the preamble, the measure was ordered to proceed. The principal object of the Bill provides for the conversion of the existing capital of the company.

Gateshead and District Tramways Bill.—It is reported that the whole of the opposition to the above Bill has been withdrawn, and accordingly it has been taken out of the group and referred to the Unopposed Bill Committee.

LEGAL.

Bristol Gas Co. *v.* The Bristol Tramway Co.

In the King's Bench Division last week Mr. Justice Phillimore had before him this case. It came before his Lordship in the form of a special case stated by an arbitrator for the opinion of the Court.

Sir Alfred Cripps, K.C., Mr. F. E. Weatherley and Mr. A. A. Bethune appeared for the gas company, and Mr. Simon, K.C., and Mr. Balfour Browne, K.C., were for the defendants.

Sir Alfred Cripps said the question raised by the special case really depended upon a point of construction, all the facts answered having been found in convenient form by the arbitrator. The question at issue was whether the tramway lines as laid down in Bristol caused certain inconvenience and additional expense to the gas company when they desired to deal with their mains and pipes. In the Tramway Act there was a proviso as regarded the additional expense so thrown upon the gas company, entitling them to be paid. The arbitrator had found partly in favour of the gas company and partly against them. The proviso, upon which the whole case rested, provided that "any additional expense imposed upon them by reason of the existence of the tramway in any road or place where any such mains, pipes, tubes, &c., shall have been laid before the construction of the existing tramway, shall be borne by the promoters." The first contention was that this proviso only applied to additional expenses where there had been actual interruption of their tramway traffic. The arbitrator found in favour of the gas company on this point. The other issue was that the gas company said they were entitled to additional expenses when it was thrown upon them by reason of the existence of a tramway in a road where a gas main was laid prior to the construction of the tramway. On that issue the arbitrator found against the gas company. The gas company claimed £115, and the arbitrator gave them £37. Learned counsel having read the arbitrator's award in detail and the reasons upon which he based that award, proceeded to argue that under the true construction of the proviso the gas company were the first in occupation of the roads affected for the purpose of laying their pipes, &c., and the tramway company came second. Both had statutory powers, and, of course, the gas company allowed them to come, but it could only be on the terms that if the gas company incurred any additional expenses by reason of the advent of the tramway company, the latter should make that expense good. The first-comer had the statutory right to lay down mains and pipes, and he ought not to be put into any worse position, because the tramway company had subsequently secured statutory rights over the same street.

Mr. Simon, K.C., in his reply, argued at considerable length as to the true construction of the language of the Act, and denied that the tramway service had caused the interruption alleged by plaintiffs to the work they desired to carry out upon their pipes, &c., and further, it was the duty of the gas company to give the defendants sufficient and proper notice when they desired to work on any of the pipes

beneath the tram rails. Had they done so the defendants would have been able to regulate their traffic so as to cause plaintiffs a minimum of inconvenience. The gas company had to act reasonably in the matter.

The gas company by their claim were simply asking the tramway company to bear the cost of all additional repairs, &c. Plaintiffs were trying to impute a view more favourable to themselves than the order entitled them to take. They had a main laid in a street occupied also by the tramway company, and they were claiming that all the functions to that main, subsequent to the advent of the tramways, including the laying of pipes to new houses, &c., were additional expenses which should fall upon the tramway company. He submitted that the Court could not reasonably construe the Act in such a light.

His Lordship, in giving judgment, said he thought the award of the arbitrator was right all round. It had been suggested by Mr. Cripps that wherever the gas company was in occupation of a road by reason of having a main down it, whether or not with service pipes, it was to be entitled in view of the statute to lay down such further service pipes as it might need to supply further demand, and in view of the fact that it was the first occupant, it was entitled to claim from the tramway company, any extra expense due to the laying down of such service pipes, &c., and, of course, for the altering of them and repairing of them once they were laid down. It might be said, on the one hand, that the gas company had gone to considerable capital expenditure, and were under many statutory obligations and restrictions, therefore it was only fair that they should be allowed to fully develop. On the other hand, it might be said by the tramway company: "By all means keep your *status quo*. You had certain mains and pipes when we came, and those mains and pipes you shall take up, restore and repair, and we will pay the additional cost. If, however, you are going further than that, then you ought to do it at your own cost." He imagined in practice that would only happen where the building area and the standard of comfort was increasing, and thus new lines of service pipes were required. Thus the laying of such pipes, in his opinion, must be regarded as new development on the part of the gas company. If the main had to come up or the position of the main had to be altered, the company would be entitled to any additional expense of the work, or if any existing pipes had to come up they would also be entitled to recover additional expense on that work, but the cost of laying additional service pipes which were feeders to new houses ought to be borne by the company itself, and the tramway company ought to be considered to that extent as being in occupation before the gas company. On all points his Lordship held that the arbitrator's decisions were right, and that the award must be upheld. The appeal would be dismissed without costs.

Judgment entered accordingly.

New Arc Lamp Syndicate *v.* White.

In the King's Bench Division on Thursday, April 29th, an application was made in this matter to Mr. Justice Ridley, in whose list the action was that day down for trial.

Mr. McCall, K.C., plaintiffs' counsel, said that it was a very important and complicated action concerning a new electric arc lamp.

His Lordship asked whether the hearing could be finished by the following day, as he was leaving for his Whitsuntide holidays on Monday next.

Mr. McCall did not think so. It must, he said, last some considerable time.

Mr. Justice Ridley said that his brother Channell would be taking cases from his list for him, and this case would probably come before that Judge next week if the parties had no objection.

Mr. Simon, K.C., representing the defendant, asked that the case might remain in his Lordship's list, so that they would be able to make an application in the event of its not being convenient to the parties to have the case heard on Monday next.

Mr. McCall did not object, and his Lordship consented to the case remaining in his list.

British Westinghouse Elec. and Mfg. Co., Ltd., *v.* Braulik.

Mr. Walter, K.C., applied that this action, which was down for trial before Mr. Justice Joyce in the Chancery Division, might stand over until next sittings. Counsel stated that the reason for the proposed adjournment was that there was an appeal pending in another case which would affect this action, and his Lordship allowed it to stand over as asked.

Seebold *v.* Page & Miles, Ltd.

(*Continued from page* 712.)

Mr. Woodley, electrical expert, cross-examined by Mr. Marshall Hall, said he considered there were many defects in the plant. He made a report on the plant on November 5th, 1907. He had put up many suction plants himself. He said that exhaust pits were condemned by the whole of the engineering world.

Mr. Hall suggested to the witness that the explosion was caused through those who tended the engine, but witness denied that. He suggested that the original belt was bad, and not large enough for the work it had to do. He did not agree that the plant in question was properly erected.

Mr. A. Crouch, a builder, examined, said that when Mr. Seebold was going to have the electric light put in he was engaged to do the foundations and to make the pits. He never had any detailed plan, but he worked from verbal instructions.

The case for the defence was then commenced, the first witness called being Mr. Geo. Phillips, who had been in the service of the defendants for many years. He said he submitted various estimates to the plaintiff in regard to the work to be done, and in competition the fourth estimate sent in was accepted. The plan put in showed all the work that was done by Crouch, and a plan was left at the works all the time they were on. He did not give Crouch daily instructions as to the work. The whole of their work was carried out in accordance with the plan. While he was there the machinery worked satisfactorily in every way. He ran it for about three weeks. Plaintiff never expressed dissatisfaction then. Plaintiff in May took possession of the machinery and paid them the balance of their account. They did not think that the man plaintiff engaged to look after the machinery was of sufficient experience, but plaintiff thought otherwise.

Hearing further adjourned.

Taylor *v.* The Auto-Claw Co.

Before Mr. Justice Eve in the Chancery Division, on Friday, Mr. Mansfield moved in the action of Taylor *v.* the Auto-Claw Co. for the appointment of a receiver for which he had previously asked. They had, he said, paid the others off and had got the transfer.

His Lordship made an order accordingly.

Macauley and Wife *v.* The Great Northern, Piccadilly and Brompton Railway Co.

This case came before the Court of Appeal, consisting of the Lord Chief Justice and Lords Justices Moulton and Farwell, on Thursday last week, on the appeal of the plaintiffs from a judgment of Mr. Justice Lawrance, after the trial of the action with a special jury. The action was brought to recover damages for personal injuries sustained by the plaintiffs—husband and wife—through the alleged negligence of the defendants.

The facts were reported in the Electrical Review for December 4th, 1908, when the previous hearing took place.

At the conclusion of the arguments of Counsel, their Lordships held that there was abundance of evidence to justify the findings of the jury, allowed the appeal, and entered judgment for the plaintiffs.

The Consolidated Nickel, Tin and Copper Mines, Ltd., *v.* Crompton & Co., Ltd.

In the High Courts of Justice this week the Official Referee, Mr. Muir Mackenzie, had before him another action involving the efficiency of electric pumping plant for mining purposes. The plaintiffs were the Consolidated Nickel, Tin and Copper Mines, Ltd., of Fenchurch Street, E.C., and the defendants, Messrs. Crompton & Sons, Ltd., electrical engineers, of Salisbury House, London Wall.

By a contract in writing it was agreed that the defendants should install in their Wheal Busy Mine, in Cornwall, for the sum of £1,640, an electrical pumping plant for the purpose of pumping the mine free from water. The installation was to be capable of delivering 1,000 gallons of water per minute against a total head of 120 ft. including friction. This contract was contained in letters which passed between the parties during the months of February and March, 1907. Plaintiffs also alleged that it was agreed that the defendants should deliver and fix the plant and machinery at the mine on or before May 24th, 1907, and that, in the event of their failure to do so, the defendants should pay plaintiffs by way of liquidated damages for the non-completion of the installation a sum equal to 1 per cent. of the contract price for every week's delay for the first three weeks, and 10 per cent. for every additional week. When the defendants made the contract they were quite aware that under the terms of their licence the plaintiffs were bound to install a pumping plant of the above capacity in the mine by June 20th, 1907, and if they failed to do so they were liable to forfeit their lease. In entering into the contract, the plaintiffs left it to the defendants' skill and judgment to supply plant and machinery reasonably fit for the purpose, and plaintiffs alleged that there was an implied warranty that they would do so. They declared, however, that defendants, in breach of the contract, had failed to deliver the plant and machinery, or to complete the same and set it in proper working order by May 24th, 1907; that they had not yet completed their contract, and were liable to the penalty mentioned; further, that the defendants had failed to supply machinery capable of doing the work stipulated, and what they had supplied was not reasonably fit to pump the water out of the mine, or, indeed, out of any mine. By reason of this, plaintiffs alleged that they had been unable to pump the water out and to win the mineral in the mine. They had spent large sums of money in endeavouring to clear the mine of water, which had been lost, and they were suffering damage by having to pay rents for the mine and wages of workmen. In all these respects they claimed damages against the defendants.

For the defence Messrs. Crompton declared that they did deliver the machinery, and that the pump and plant so supplied was able

to fulfil, and, in fact, did fulfil, all that was stipulated by the contract. Alternatively, they contended that if the pump and machinery failed to fulfil all that was required, the failure was due to the negligence of the plaintiffs in not providing skilled and competent workmen to work and manage the installation, and was not due to any breach of contract on their part. They counterclaimed £1,040, the balance of the price agreed, plaintiffs having paid only £600 of the £1,640.

Mr. C. A. Russell, K.C., with Mr. Schiller, was for the plaintiffs, and defendants were represented by Mr. Abel Thomas, K.C., and Mr. J. Sankey.

Mr. Russell, dealing with the history of the case, stated that on June 20th, 1903, three gentlemen named Adler, Norbett and Williamson, acquired the lease of the mine in question from Lord Falmouth. The mine had been shut down, and had become filled with water. The main purpose of these three gentlemen, who took the mine on behalf of the plaintiff company, was either to work the tin in the mine for themselves, or, when the mine had been re-opened, to dispose of it to other persons who would work it. The object of Lord Falmouth was that the mine should be pumped clear of water and restored to a condition capable of producing ore. Under the licence the plaintiffs were to search for tin and other minerals for a term of 21 years. They were further bound under the terms of the lease to procure and have in working order a modern pumping plant capable of delivering 1,000 gallons of water a minute by or before June, 1907. In default of so doing they were liable to forfeit their lease. After obtaining quotations from Messrs. Crompton's, whom they accepted as being skilled in such matters, they left it to them to propose what would be an efficient plant. The obligation under the lease was to pump to a depth of 20 fathoms at the rate of 1,000 gallons a minute against a head of 120 ft. in addition to the friction head, and this was stipulated for in the contract. The specification which was put forward by the defendants, and finally adopted, stated that they proposed to supply "a 75 to 80-B.H.P. suction gas engine and producer plant suitable for use with anthracite coal; the engine capable of that output at 180 to 200 R.P.M. with heavy fly-wheel for belt driving." The specification described the generator as "having stationary armature and revolving field system." That, he presumed, represented the approved modern practice; as a matter of fact, the generator which defendants eventually supplied had a revolving armature and stationary field. The sinking pump, said the specification, was of the turbine multi-stage vertical spindle pattern, direct-coupled to one of their standard vertical-spindle, totally-enclosed three-phase induction motors of 55 H.P., running at a speed of 1,456 R.P.M. on a 550-volt 50-cycle circuit. This pump might have been all very well had it had a sufficiently powerful motor to drive it. Plaintiffs contended that the pumping set, as a whole, was not capable of performing the duty allotted to it, and their complaint was directed principally against the motor. The specification also stated that a flexible ball bearing would be provided to take the weight of the armature and shaft, and also a flexible coupling between the motor and the pump. This, said counsel, was material, because of the innumerable suggestions which had been made with regard to trouble plaintiffs had experienced from the overheating of the motor, &c. In one of their letters, defendants told his clients that they had "put forward"—he particularly called attention to those words—a three-phase alternating-current scheme, because with this arrangement there would be no commutator or rubbing contacts whatever on the motor, and no attention would be required for the electrically-driven sinking pump other than lubrication. This showed, beyond a doubt, that plaintiffs left it to the defendants to put forward the plant they thought would be the most suitable and efficient. The defendants apparently placed a great deal of the work with sub-contractors, and on May 24th only a portion of the plant was on the site. Plaintiffs managed eventually to get the lease extended. When sufficient machinery was installed to start pumping the progress of the work was retarded by a series of breakdowns to the motor, &c. On one occasion the main bearing of the motor seized, and it was found that the rotor was burnt out. A temporary repair was effected, but eventually the motor had to be sent away for repair. Other breakdowns occurred at different intervals, and on each occasion the water gained in the adits of the mine. So badly had the plant run that plaintiffs had not carried the pumping down more than 100 ft. below the adit level, because they were afraid that if they put a greater load upon the plant a breakdown would result and the mine would be flooded again.

Mr. E. H. Williamson was called, and stated that he was manager of the Mining Co. He, with Messrs. Norbett and Adler, obtained the licence of the Wheal Busy mine from Lord Falmouth. The adits to which the water had risen were 147 ft. below the ground, and he and his colleagues were desirous of clearing the mine in order to see if there were any mineral rights there and then exhibiting them to certain French engineers. Witness made no suggestion as to what plant should be used; they left that to Messrs. Crompton. The penalty of 1 per cent., &c., for delay was the defendants' own suggestion when the contract was entered into. He thought the last piece of machinery came about July 23rd. Negotiations with the French engineers fell through, and the mine was not unwatered sufficiently to commence work in it until March, 1908. He did not think it had ever been unwatered completely. When the pump failed, they got a temporary pump on defendants' suggestion, but when it arrived, they had to incur further expenditure on it in connection with valves, &c. The Wheal Busy mine was situate in the district of Cornwall where arsenical ores were to be found. Generally speaking, there was ochre in the water which flooded Cornish mines.

(To be continued.)

BUSINESS NOTES.

The Building Trades Exhibition at Olympia.—In addition to the exhibits mentioned in our last issue, we observed in our tour of the Hall a number of other stands of electrical interest. Some very fine, and to us somewhat unusual, examples of electric light fittings, were shown by the Birmingham Guild of Handicraft, Ltd. Choice copies of silver-plated candle fittings as supplied for used on Lord Howard de Walden's private yacht, were exhibited, while other specimens included a special line of fittings (to hold four 50-C.P. Osrams), such as had been furnished by the firm for the Glasgow Liberal Club. We gathered from conversation here that the electric fittings trade of the country is on the alert for a big revival of the building trades—that is what is required; may it come soon! Messrs. R. W. Blackwell & Co., Ltd., had, among other things, insulating and sheathing papers; the India Rubber Co., of Silvertown, had a striking stand where "mosaic" rubber tiling was effectively displayed; Messrs. Heenan & Froude, Ltd., whose name is inseparable from refuse destructors were present; Messrs. R. Waygood & Co., Ltd., had at work an electric passenger lift conveying passengers to the gallery, also a working model electric "push-button" lift; Mr. James Gibbons, of Wolverhampton, among his various art metal work, showed electric light fittings; The Seyssel and Metallic Lava Asphalte Co. had a skeleton model of the L.C.C. generating station at Greenwich, which they had recently asphalted; Medway's Safety Lift Co. displayed their electric passenger lift gear, and push-button electric lifts; Messrs. Pinchin, Johnson & Co., Ltd., exhibited varnishes and rust preventing paints; portable railways, as would be expected, were to be seen at the stand of Mr. Arthur Koppel; Messrs. R. Hornsby and Sons, were present with a Hornsby-Stockport suction gas plant and gas engine set with Lancashire dynamo, the whole forming a country house electric lighting installation; water softeners were shown by Mr. Wm. Boby; Messrs. Tredegar & Co., of Victoria Street, exhibited an electric lighting set for country houses, also wooden fittings; the Titan Lift and Electric Co. had a small stand with their electric push-button passenger and goods lifts; Hughes and Stirling were demonstrating their refuse destructor models at work; while Messrs. Goodrich & Hamlyn were present with improved boiler furnaces and other fuel-saving devices, Messrs B. J. Hall & Co., with their patent electric copier, and Messrs. Lassen and Hjort with water softeners.

Messrs. W. H. Allen and Water Turbines.—In view of the great demand which has arisen for hydraulic turbine machinery, Messrs. W. H. Allen, Son & Co., Ltd., of Bedford, have come to an arrangement with Messrs. Piccard, Pictet & Co., of Geneva, to manufacture water turbines of large size to their designs. This firm is one of the leading manufacturers in Europe of water turbines of the Francis high-speed type, and its great experience is at Messrs. Allen's disposal. It is interesting to remember that some years ago water turbines formed one of Messrs. Allen's principal specialities, but owing to the rapid increase of other branches of their business, they were unable to develop their water turbines to the same extent. They are now again taking up this interesting subject with a view to manufacturing complete installations for hydro-electric power stations. We hope that this means that the firm will have very important foreign work of this description before long. Messrs. Allen always have been very watchful of the developments of foreign countries, and in this matter of hydro-electric plants, there ought to be much for them, and for other British firms, to do in Spain, in India, in South America, in Japan, and so on.

Condensing Plants.—Messrs. Willans & Robinson, Ltd., of Rugby, who during the past few years have paid considerable attention to the manufacture of surface condensing plants, have now extended this department of their business to include condensers of the jet type, particularly condensers built on the counter current and barometric column principles. Due to the large number of instances where condensers of the jet type are required in connection with exhaust steam turbines, special arrangements have been made for the manufacture of this class of condenser.

Catalogues and Lists.—Messrs. Siemens Bros. and Co., Ltd., Caxton House, Westminster.—March supplement to their Electro-Medical Catalogue, dealing with switchboards for adding to ordinary X-ray outfits in order to make them suitable for rapid and instantaneous radiography. The switchboards are made in various types, with automatic control as well as with hand control. The firm has also just issued a fine 116-page catalogue (No. 512) of "Switchboard Instruments." This publication contains a very large amount of information, with many tables of sizes and prices, and a number of clear half-tones and innumerable scale diagrams and dimension sketches. The pictures include views of the testing and calibrating rooms at the Woolwich works. A very wide range of instruments is covered in the book. Electromagnetic instruments are represented by some 12 patterns each of ammeters and voltmeters, with ranges from 2 to 1,000 amperes and 1 to 700 volts respectively. Of the moving-coil type there are about 22 patterns each of ammeters and voltmeters; these instruments are built on the Deprez d'Arsonval system. The Ferraris instruments (induction type) are represented by some 16 patterns each of ammeters, voltmeters and wattmeters. A special feature is made of the method of mounting instruments on brackets and pedestals

of which a large variety are listed, whilst interest attaches to the range of apparatus for synchronising and parallel running of alternators. Amongst other useful devices, there is listed a central station telegraph, for transmitting orders between switchboard gallery, engine room and boiler house; a large assortment of leakage current meters and relays, and various indicators for earth, current direction and rotary field direction. Messrs. Siemens make a prominent feature of their current and pressure transformers for use with switchboard instruments. The recording instruments section contains their spark-recording type.

Messrs. Ward & Goldstone, Sampson Works, Salford.—Leaflet relating to the "Guardian" hand lamp, the lampholder of which is entirely insulated and isolated from exposed metal parts, the holder and cap being entirely enclosed in a strong insulated handle; also a list of auto-transformers with tabulated prices.

The Atlas Carbon and Battery Co., Ltd., Ewer Street, S.E.—A number of new publications; two are coloured leaflets of Atlas porous pots and "Dania" dry cells; a third is a four-page illustrated price list of "Dania" ignition and lighting batteries; while the last is a 32-page well-produced illustrated catalogue of primary batteries for telegraphs, telephones, ignition, lighting and bell, and other work.

Mr. Paul Behrens, 18 and 19, Queenhithe, E.C.—Mr. A. H. Midgley, as British and Colonial agent, has opened offices at the above address where he is offering for the coming season a variety of "Gem" fans and small motors which we understand he has specially designed for the home and Colonial markets. It is stated that no moisture absorbing material is used in the construction, the resistance plates are of glazed porcelain, and the motors are fully enclosed. An illustrated catalogue of these manufactures, giving prices of same, is to hand.

Mr. George Ellison, Birmingham.—Picture card showing his circuit breakers with a calendar for the month of May beneath.

Messrs. Krupka & Jacoby, 61 and 62, Watling Street, E.C.—A number of illustrated and priced leaflets relating to the following manufactures:—Tantalum lamps, new high voltage ditto, Tantaphane electric light fittings, electric ventilating fans, metal case indicators, electric radiators, high voltage electric trumpet alarm, direct-current motors, &c.

Messrs. Marsh, Son & Co., Ltd., 15, Gerrard Street, Soho, W.—Hanging card showing an illustration of one of their latest types of automatic switches for breaking circuits at pre-determined time. The mechanism is of British manufacture. The clock is an eight-day double spring English escapement movement. The switch is stated to be ample for its carrying capacity, having substantial copper blades, and it will readily carry 20 amperes. The break is large and positive, being suitable for voltages up to 500.

Schiersteiner Metallwerk, Schwerinstr, 3, Berlin W., 57.—Leaflets Nos. 24 and 30, showing automatic switches for electric signs, with diagrams of connections.

Messrs. Ludw. Loewe & Co., Ltd., Farringdon Road, E.C.—New catalogue (B3) giving, in the course of 32 pages full, and very plentifully and clearly illustrated, particulars of the D.W.F. ball bearings. Typical applications are shown, including their use on dynamos and motors. Tabular matter gives details of sizes, weights, and prices. The catalogue will doubtless be of special interest in all shops interested in the reduction of friction by this means.

Messrs. A. and P. Steven, 231-2, Strand, W.C.—Particulars of their new design of pump which embodies novel features in the arrangement of the suction pipe and valves, and other improvements.

Mr. Chas. E. Miller, New York, U.S.A.—Annual illustrated catalogue (236 pages) of a host of parts for motor-cars, motor-boats, and motor-cycles.

The Accessories Manufacturing Co., Ltd., 9 and 10, Wells Street, Oxford Street, W.—40-page illustrated catalogue giving particulars and prices of a number of electric lighting and power accessories, all of English manufacture, and with brass parts mounted on Association china. For the convenience of customers abroad there have been included in this issue of the catalogue, the approximate weights of the firm's leading specialities. Among a number of lampholders, tumbler switches, ceiling roses, cut-outs, wall plugs, fuseboards, main switches, fittings, and so forth, we especially note the A.M.C. key-bayonet lampholder, a selection of flush switch-plates, and wall plugs for special purposes.

Messrs. Verity's, Ltd., 31, King Street, Covent Garden.—Leaflet drawing attention to their "Aston" motors and dynamos, which are specially designed for service in tropical countries.

"Invincible" Pumps.—We learn that the "Invincible" centrifugal pumps of Messrs. Gwynnes, Ltd., have been awarded a Gold Medal at the Nagpur Exhibition, which took place in November last.

Book Notices.—"Telegraphists' and Telephonists' Note Book." London: S. Rentell & Co. Price 1s. 6d. net.

"Rules for Recovering Coal Mines after Explosions and Fires." By W. E. Garforth. London: *Colliery Guardian*, Ltd. 1909. Price 3s. 6d. net.

"The Composition of Commercial Petrols." By Bertram Blount, F.I.C. Excerpt from the *Proceedings* of the Incorporated Institution of Automobile Engineers. From the author.

"Science Abstracts." Vol. 12, Part IV. April, 1909, Sections A and B. London: E. & F. N. Spon. Price 1s. 6d. each part.

"Journal of the Association of Teachers in Technical Institutions." Vol. II, No. 2. April, 1909. London: St. Bride's Press, Ltd. Price 1s.

"The Commercial Engineer's Pocket-Book: Electricity Supply.—A handbook for Publicity Department Managers, Electricity Supply and Contractors' Representatives." By F. H. Davies. London: H. Alabaster, Gatehouse & Co. 1909. Price 1s. 6d. net.

Dissolutions and Liquidations.—Auto-Claw Co., Ltd.—This company is winding-up voluntarily with Mr. S. P. Child, 8, Frederick's Place, Old Jewry, E.C., as liquidator. A meeting is to be held at that address on May 11th.

La Plata and Ensenada Tramways Co., Ltd.—This company is winding-up voluntarily with Mr. J. H. Swinburn as liquidator.

Messrs. Veitch & Fenn, electrical engineers and art metal workers, 53, South Molton Street, Oxford Street, W.—Messrs. W. Veitch and A. Fenn have dissolved partnership. Mr. Veitch attends to debts.

Messrs. Bingham & Hall, ironmongers and electricians, Parkstone, Poole.—Messrs. G. Bingham and A. H. Hall have dissolved partnership. Mr. Hall attends to debts.

Fearnside & Glover, electrical engineers and contractors, Burke's Building, John Street, Bradford.—Messrs. F. Fearnside and H. Glover have dissolved partnership. Debts will be attended to by Mr. Fearnside, who will continue the business.

Geary, Rippin & Co., electrical engineers, 25, Central Arcade, Wolverhampton.—Messrs. F. C. Geary and F. S. Rippin have dissolved partnership. Mr. Geary attends to debts, and continues the business.

Morrison & Roebuck, electrical engineers, 4, Birley Street, Blackpool.—Messrs. G. Morrison and J. W. Roebuck have dissolved partnership.

Private Meeting.—Charles Pullan, electrical engineer, King's Arcade, Bradford.—The creditors of the above were called together last week when an approximate statement of affairs, as at April 23rd last, was presented. This showed liabilities amounting to £2,543 of which £493 was due to trade creditors, the balance of £2,049 being in respect of cash claims. There were also fully secured creditors for £10, the securities held being valued at £18. After allowing £118 for preferential claims, the assets were estimated to produce £292, the estate thus showing a deficiency of £2,251. The assets were as follows:—Cash at bank 17s. 10d., stock on hand, work in progress and fixtures and fittings £662 10s., estimated to realise £200, book debts £263 12s. 6d., valued at £200, and surplus from securities in the hands of fully secured creditors £8 11s. It was pointed out that the estate thus showed 2s. 3½d. in the £. It was reported that the debtor commenced trading for himself in June, 1905, with a small capital. During the first year his turnover was a little over £700, while during the succeeding 12 months it was about double. For the year ended June, 1908, the turnover was £3,300, and since that date the sales had been between £2,600 and £2,700. The debtor was unable to give exact details of his expenditure, and he attributed his present position to bad debts and losses on contracts. He also stated that he had lost money through dishonest employés. After some discussion it was resolved that Mr. Paton, C.A., Bradford, should realise the estate under a Letter of Authority. The cash creditor agreed to postpone his claim until the trade creditors had received 4s. in the £.

Trade Announcements.—We have received from Messrs. Scholes & Farrington, solicitors, 49, Princess Street, Manchester, a letter written on behalf of Messrs. George H. Scholes and Co., of Blantyre Street, Chester Road, Manchester, stating that the notice appearing on page 673 of the Electrical Review of 23rd ult. under "Trade Announcements" has led to their clients being confused with Scholes & Co., of 4, Corporation Street, Manchester. We are asked to point out that they have no connection with the firm mentioned in our notice. Messrs. George H. Scholes & Co., to whom, of course, we did not refer, are still carrying on their electrical engineering business at Blantyre Street as heretofore.

Messrs. Mawdsley's, Ltd., Zone Works, Dursley, have appointed Messrs. C. E. Lugard & Co., Field's Buildings, Middlesbrough, as their representatives for the North-East Coast for their "Mawdsley" patent improved continuous-current dynamos and motors.

The Jandus Arc Lamp and Electric Co., Ltd., announce that their offices and show-rooms are now situated at their works, at Hartham Road, Holloway, additional premises having been acquired for this purpose. This is their only address, the sole agency agreement with Messrs. Drake & Gorham, Ltd., having been terminated, as we announced last week. Additional workshop space has also been secured to cope with the increasing demand for regenerative flame lamp. We have received a copy of a 12-page booklet entitled the "Making of a Modern Arc Lamp," in which the factory is illustrated and described. A map showing how to reach the works is given as a frontispiece. It will be remembered that the Jandus Arc Lamp Co. was formed to manufacture the first enclosed arc lamp, and the success was such that many firms were licensed by them. Licensed concessions have now been granted to various large foreign firms to manufacture enclosed flame lamps in all the European countries, the United States and Canada. We understand that consequent upon the increased space at Hartham Works, the Jandus Co. are in a position to cope with the rapidly increasing demand for these lamps. The plant already installed is sufficient for the manufacture of 12,000 lamps per annum. A special factory has already been laid down for the manufacture of the patented carbons used in conjunction with the Jandus enclosed flame lamp.

Bankruptcy Proceedings.—*Re* Arnold Roberts (trading as Roberts Bros.), Bradford, electrical engineer.—The public examination was held at Bradford on April 28th. The gross liabilities amounted to £3,100, of which £2,431 was expected to rank. The deficiency was £1,597. Debtor stated that prior to 1902 he was employed as an engineer's assistant, and after that he commenced business in partnership with his brother. In 1906 he was making a profit, but the following year there was a small loss,

and in 1908 there was a loss of £238. In the last 10 months his trading showed a loss of £1,924. This loss was partly due to his taking a Corporation contract at £1,420. The Official Receiver suggested to the debtor that he contracted at a ridiculous price, his figure being £300 lower than the next tender. Debtor replied that the next tender was only £85 higher than his. The examination was closed.

BRIDGEWATER & WRIGHT, 78, York Road, King's Cross, electrical engineers.—Under a receiving order made on March 16th last, a sitting was appointed to be held last week before Mr. Registrar Giffard, at the London Bankruptcy Court, for the public examination of the debtors. The receiving order was made on the petition of Messrs. Miles, Druce & Co., Upper Thames Street, E.C., iron merchants, the act of bankruptcy being failure to comply with the requirements of a bankruptcy notice. Mr. E. Leadam Hough, Senior Official Receiver, reported that the first meeting of the creditors stood adjourned until the following Monday, to enable the petitioning creditors to consider the position and the desirability of applying to the Court for a rescission of the receiving order and for an administration order. There was some doubt as to the persons constituting the firm. Under those circumstances, he suggested that the public examination should also be adjourned. His Honour postponed the hearing until May 12th.

The adjourned first meeting of creditors was held on Monday at the London Bankruptcy Court. Mr. E. Leadam Hough, Senior Official Receiver, reported that the chief business of the meeting was to consider against whom the order of adjudication should be made, and as it appeared that Mrs. Rex had carried on the business as executrix, that lady had doubtless rendered herself liable for the debts, and the Court would probably make the order against her. He had received various proxies in favour of the appointment of Mr. E. H. Hawkins, I.A., as trustee, but he thought that gentleman would be very foolish to accept the office. A resolution was passed for Mr. Hawkins to fill the office of trustee, and, in the the event of his refusing to act, that the matter should be left in the hands of the Official Receiver, to be wound up in the ordinary course.

H. J. FURNISS, electrician, 5A, Queen Street, Derby.—May 19th is the last day for the receipt of proofs for intended dividend, by Mr. F. Stone, 47, Full Street, Derby, the trustee.

"Simplex" Model Home at the White City.—MESSRS. SIMPLEX CONDUITS, LTD., are erecting a model Electrical Home at the forthcoming Imperial International Exhibition, which opens this month at Shepherd's Bush, and for this purpose they have secured a large space in the grounds of the White City. Their object is to popularise the name "Simplex" in connection with metal-filament lamps, electrical cooking, heating, and ventilating apparatus, and other electrical goods sold by them. In this connection the company has written to Mr. L. G. Tate, the Secretary of the Electrical Contractors' Association, as follows:—"In order to secure a maximum advantage from this undertaking, it will

THE SIMPLEX MODEL HOME.

be unavoidable that a certain number of transactions will take place with the general public. As this is a departure from the policy which we have always pursued, and which we intend to continue, of dealing only through the contractor, we have given the matter some consideration, and as evidence of good faith our directors have decided to pay into your Central Fund a sum to be disposed of in any manner your Board may think fit, equivalent to 5 per cent. upon the gross value of all such sales as may be effected at our exhibit above mentioned. We trust this will meet the views of your members, and be acceptable to them." We give an illustration of the proposed building. The site occupied is situated between the Garden Club and the Grand Restaurant, in the Elite Gardens, and has an area of 1,000 sq. ft. In addition to the large showroom there is an electrically-equipped dining-room, drawing-room, bedroom and kitchen, with the object, as mentioned above, of bringing before the public notice the domestic applications of electricity.

New Zealand.—The work of constructing the long tunnel which is to replace the wooden flume, in connection with the Waipori scheme, has been commenced. It is hoped to develop 4,000 H.P. with the increased water supply, and it is considered that the larger supply then available will easily place the Dunedin undertaking in a satisfactory financial condition.

LIGHTING and POWER NOTES.

Accrington.—The Corporation intends to hold an electrical exhibition in the Town Hall shortly, and the Council is recommended to grant £100 towards the expenses.

Barnstaple.—At a meeting of T.C. on Monday, the Finance Committee in its half-yearly statement reported that the electric light deficiency of £476 represented the loss on the past year's trading, but was considerably less than the loss in the previous year. Mr. H. Barrett, a member of the Committee, explained that in the estimated revenue from public lighting there was a reduction of £216, due to a change in the lamps. There was no loss on the electric light deficiency account. The proper way would have been to have said that the revenue account of the electric light undertaking was insufficient to meet charges by £476.

Beckenham.—At Monday's meeting of the Council a communication was reported from the B. of T. pointing out in reference to the proposed linking up between the Beckenham Council's and the South Metropolitan Co.'s undertakings as a provision against a breakdown, that whilst the company is authorised to supply Beckenham, the latter place under the existing law cannot reciprocate. The clerk reported that the Bill introduced by the B. of T. in the present session of Parliament, will, if passed into law, provide the necessary authority. The matter was allowed to stand over until the fate of the Bill is determined.

British Columbia.—The Canada Zinc Co. has started an electric smelter for lead and zinc at Nelson. This is to deal with 15 tons per day; 800 to 1,200 H.P.-hours are required per ton of charge, according to the zinc content, and the electrode cost similarly varies from £5 to £20 per ton of charge.

Canada.—An estimate of water-powers was given recently by Mr. R. E. Young, superintendent of the Dominion railway lands, to a Committee of the Canadian House of Commons. The total horse-power known to be available is 25,682,907, distributed as follows:—17,075,939 in the Province of Quebec; 3,129,168 in Ontario, exclusive of Niagara Falls; 2,000,000 in British Columbia; 1,000,000 in Alberta; 600,000 in North-West Territories; 504,000 in Manitoba; 500,000 in Saskatchewan; 54,700 in Yukon; 150,000 in New Brunswick; and 54,000 in Nova Scotia. This approximate estimate, Mr. Young considers, is quite a conservative one.

Chelmsford.—The T.C. has accepted the tender of the Electric Supply Corporation for lighting 11 incandescent electric lamps in Ramsford Road, Waterhouse Estate, and Writtle Road, at £3 3s. per lamp per annum.

Continental Notes.—SWEDEN.—The charges for electrical energy supplied by the South Swedish Power Co. have been definitely fixed at the following rates:—For energy to be used for industrial purposes exclusively, 12 öre ($1\frac{2}{10}$d.) per KW.-hour; if the consumption exceeds 10,000 KW.-hours the price will be reduced to 11 öre ($1\frac{6}{10}$d.), and for more than 600,000 KW.-hours it will be reduced to 5 öre ($\frac{1}{10}$d.) per unit. For lighting purposes the charge will be 18 öre ($2\frac{8}{10}$d.), but for a consumption of not less than 1,000 KW.-hours per annum, this is gradually reduced to 13 öre ($1\frac{3}{10}$d.). For energy required regularly during night hours a rebate of 50 per cent. of the above-mentioned prices will be allowed. It will be seen that these charges do not differ materially from those obtaining in some of our own towns and districts.

The Swedish Co. "Electrometall," at Ludvika, is making preparations for building electric furnaces for the smelting of iron-ore for the manufacture of pig-iron in Norway on a large scale. To start with, it is intended to erect two reduction furnaces of 2,500 H.P., as well as two electric furnaces with a capacity of 600 H.P. each. Later, the plant is to be extended with four furnaces of both kinds, making eight in all, and it is further intended to combine this plant with manufactories of various kinds, with the view to utilising the products of the ironworks for the manufacture of steel plates, &c.

AUSTRIA.—It is reported that a large electrical undertaking is to be established near the city of Fiume, utilising the fall of the River Gracka, which passes near the city of Otocaco. In connection with the work it will be necessary to excavate a tunnel of considerable length, which would enable 36,000 H.P. to be developed immediately, and it is believed that subsequently the works might be enlarged to 100,000 H.P. In that case some of the power would be transmitted to Abbazza and other Dalmatian towns, also serving for the electric traction on the Fiume-Kameral-Moravica railway.

BELGIUM.—A somewhat remarkable development is just now taking place as regards the adoption of electricity both for lighting and power purposes in Belgian collieries. During the past year one concern alone, the Société de Constructions Electriques de Charleroi, has established electric power generating plants at the Ressaix Collieries, at the pits of the Carabinier Co., at Pont-de-Loup, at those of Haine-St.-Pierre, La Hestre, Houssu, Ormont, Courcelles-Nord, &c. Electrically-operated winding engines have also been installed at the pits of the Société des Houilleres d'Anderlues, and at the Baulet and Velaine pits of the Société Elizabeth. The same concern is also at present engaged on the establishment of electrical plants at seven other collieries in Belgium, and an electrically-operated winding engine which will, it is claimed, will be the largest in the country.

SPAIN.—An important electrical generating plant has recently been completed by the Spanish Oerlikon Co., for the Sociedad

Hidro-electric del Guardiaro, of Seville. The water power of the River Guardiaro is utilised, the plant, which is situated between Guaria and San Pablo, comprises three 1,500-H.P. turbines coupled to three-phase 5,000-volt alternators. Six transformers are employed to increase the pressure to 52,000 volts, which is stated to be the highest voltage so far employed in Europe, for transmission to Seville, a distance of about 78 miles, where it is being utilised for lighting and power purposes.

Cork.—The tramway service was entirely suspended on Friday in consequence of a strike, which has extended to the power house and the yard men. The electric light supply is now also involved, and the power house is worked by the clerical staff. A large amount of machinery in the city is worked by electrical power, including that of the newspapers.

Demerara.—In the British Guiana Court of Policy, a Bill to amend the Demerara Electric Co.'s Ordinance, 1899, was passed through its final stages and made Law No. 12, of 1909. It appears that, by a judgment of the Supreme Court of British Guiana, delivered in March, 1905, and confirmed by His Majesty in Privy Council, the operation of the machinery then in the company's power house in Georgetown was, in effect, declared to constitute a nuisance to certain householders in that city. In order to do away with the cause of complaint, the company decided to import and erect a steam turbine, and this has been done at considerable cost. The Bill provides for the reduction of the capital of the company, which at present is $850,000. Hitherto, the company has only paid 2 per cent., and, in view of the above expenditure, it is expected that shareholders will not be able to look for any return for some time to come.

Fleetwood.—With reference to our last week's note, Mr. Hansom, of the Fleetwood and District Light and Power Syndicate informs us that the railway company's inquiry as to a minimum supply of 600,000 units per annum was submitted by his company to the Local Council, as prospective purchasers of the undertaking, for agreement as to terms. The syndicate has similarly quoted the Fleetwood Ice Co. for 50,000 units per annum, and Rossal School for a complete electrification scheme.

Glastonbury.—The Board of Trade has revoked the 1904 E.L. Order.

Hull.—The question of renewing the insurance on the 500-KW. generators at the Sculcoates station was recently discussed. It appeared that owing to having lost heavily on these machines, the Insurance Co. was not willing to renew the policy, but offered to take over the recently-installed Lahmeyer machines. This the Electricity Committee agreed to.

London.—MARYLEBONE.—The Electric Supply Committee of the B.C. has presented the estimates of income and expenditure for the year ending March 31st next. The Committee considers that there is no doubt that the past year's total will amount to at least 8,840,000 units (*i.e.*, 69,000 units above the estimated sales for that year). Taking this as the basis of the probable sales for the new year, the Committee is allowing for an increase of 1,000,000 units. The average yield is expected to be 3·77d. per unit. The total cost of production, distribution, management, &c., for the half-year to December last, averaged 1·22d. per unit; the estimate for next year is 1·122d. per unit. The Committee estimates that the new scheme for public lighting will be in full operation by Michaelmas next, but should the scheme for any reason not be proceeded with, the loss thus caused will amount to £1,883, from the period from October, 1909, to March, 1910; or for a complete year, £2,500. If the scheme is put in hand without delay, however, the year's working, the Committee believes, will result in a profit of £1,341 after meeting all expenses, and diminishing capital liabilities by £35,994.

Plymouth.—The Corporation Electrical Committee, acting on the advice of its electrical engineer, has approved of the purchase of a turbo-generator of 350 KW., at an estimated cost of £2,500, to be charged to the reserve fund.

Portsmouth.—Among new works to be carried out by the Admiralty is an extension of its electric light and power station at a cost of £6,000, and installation of machinery to the value of £32,000. The electrical power station at Priddy's Hard, Gosport, is also to be enlarged at a cost of £13,250.

Rochdale.—The T.C. has applied to the B. of T. for permission to place overhead electrical lines in Falinge Road and Shawclough Road, and from Falinge Fold to the borough boundary.

South Africa.—JOHANNESBURG.—The Council is to spend some £10,800 on mechancial stokers and economisers for the municipal power station.

Stourbridge.—The B. of T. has granted a prov. E.L. order to the U.D.C.

Tasmania. — The Launceston municipal electricity works supplied over 1½ million units during the year 1908, at an average price of 2·78d. The total revenue for the year was £17,682, and working expenses £8,078, a net balance of £9,310 remaining after meeting sundry charges. The surplus after meeting financial charges was £2,108. The system is a three-phase 50-cycle one, 5,000 volts primary, 110 and 190 volts secondary. The engineer reports that radiators and flat-irons appear to be used in Launceston more extensively than anywhere else in the Commonwealth, in proportion to population.

U.S.A.—News paragraphs continue to appear in the American papers relative to the ice trouble at Niagara. Apparently one result of the packing of the ice in the Gorge below the Falls, was that it was forced over the track of the Gorge railroad on the American side, destroying miles of track, poles, wire, &c. Docks, boat-houses, pumping-stations, &c, were carried away. According to the reports of the Ontario Power Co., the water was backed up some 40 ft. above the normal, and despite the fact that the power house windows were some 7 ft. above the highest previous known flood level, ice and water forced its way in, submerging the machinery, and, of course, stopping supply. Fortunately the water receded almost immediately, and after some hundreds of tons of ice had been removed, the cleaning and drying out of the machines was taken in hand. The damage to the machinery is not expected to exceed $100,000. Lockport suffered severely, nearly every mill in the district being shut down. An attempt was made to obtain power from the Niagara Development Co., but the demand overtaxed one large generator, which had to be shut down.

Walmer.—The Board of Trade has revoked the 1904 E.L. Order.

West Bromwich.—The sales of the Corporation's electricity for the year have been as follows:—Private lighting, £3,374, an increase of £45; public lighting, £677, an increase of £39; tramway traction power, £6,599, a decrease of £552, and motive power, £2,797, an increase of £1,037, making a total from sales of £13,461, as compared with £12,877, an increase of £584.

Western Australia.—Mr. H. Edmiston, of Perth, who was engaged by the Boulder T.C. to furnish a report on its electricity station, estimates that expenditure will be necessary up to the amount of £10,000 to make alterations and provide additions to the plant. The items required include the following:—One 150-KW. steam dynamo, one 75-KW. steam dynamo, one three-wire balancer, generator and balancer panels, &c., one water-tube boiler, steam and exhaust pipes, gantry and gantry crane, steam coolers, superheaters for existing boilers, &c.

Wimbledon.—The Electric Lighting Committee has drawn a new scale of charges for power purposes; application is to be made to the L.G.B. for sanction to borrow £5,000, being the estimated expenditure upon mains and house services during the year ending March 31st, 1910, and £800, being the estimated expenditure upon meters for the same period.

Woolwich.—The Council has agreed to an assisted wiring scheme, with a rent of 7d. per lamp installed per quarter for installations in Woolwich and Plumstead, and in Eltham to charge 3s. 6d. per quarter for the necessary transformer in addition, such rents to be perpetual unless the installation is purchased.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The Tramways Committee is considering a proposal to lay a tramway up Market Street and to relay the tramway track at Woodside.

An application for increased pay by the motormen and conductors has been refused by the Committee.

Argentine.—A great strike is in progress in Buenos Ayres, the strikers being estimated at over 200,000. The work of the port is stopped, and the tramway service is only partially maintained under an armed military guard.

Blackburn.—A loss of about £4,800 has been incurred on the tramways during the past year, due to the heavy expenditure on permanent way and decreased traffic receipts, which are down 1d. per car-mile. Under these circumstances the Tramways Committee has decided to recommend the Council to vote £4,000 out of the rates towards liquidating this deficit, and it is understood that the remaining £800 will be met out of the reserve fund.

Castlecomer.—Notice has been given on behalf of Mr. R. H. Prior-Wandesforde, that an application will be made through the Kilkenny C.C., for an order authorising the construction and the equipment of tramways and light railways in various townlands in County Kilkenny connecting Castlecomer with the Waterford and Maryborough branch of the G.S. and W. Railway. Powers are also sought by Mr. Prior-Wandesforde to promote a company to carry out the scheme.

Continental Notes.—FRANCE.—The *Génie Civil* reports that single-phase traction has been adopted on two tramways, from Lyons to Jons and Lyons to Miribel respectively, having a total length of 22 km. of route. The specially interesting feature of the system is the use of a pressure of 6,000 volts on the trolley wire, at a frequency of 15 cycles. Catenary suspension is employed. There are 15 motor-cars, weighing 17 metric tons each, and driven by two motors of 45 H.P. The installation was carried out by the Société Anonyme Westinghouse, of Havre.

ITALY.—H.M. Consul-General at Genoa (Mr. W. Keene) reports that at a meeting of the Local Departmental Traffic Commission, note was taken of the general programme for the adoption by the State railways of electric traction along the Riviera lines as soon as its application to the Genoa-Giovi and Savona-San Giuseppe lines

shall have been completed, and a resolution was passed recommending its adoption as soon as possible on the Genoa-Spezia line, where, owing to the number of tunnels, electric traction would greatly increase the present potentialities of the line.

AUSTRIA.—A project is being prepared for a line of ordinary gauge, 16 km. in length, from Chieti to Francavilla-on-the-Sea. The slope is a gradual one, Chieti being 100 metres above sea level, and the terminus at Francavilla only 6 metres above sea level.

Llandudno.—Much local interest is being shown over the question of running cars to the summit of the Great Orme's Head on Sundays. Recently the Council decided to grant permission to the tramway company, and also refused to take a poll of the ratepayers on the subject. However, a poll was organised by some public-spirited individual, and the result was declared on Saturday as follows:—Against Sunday trams, 666; for Sunday trams, 518—majority against, 148.

London.—SOUTHWARK.—The B.C. has been informed by the L.C.C. that it will proceed at an early date with the construction of tramways to the southern approach of Blackfriars Bridge, and from Blackfriars Road *via* Southwark Street to Southwark Bridge Road.

Nelson.—The annual report of the Nelson Corporation Tramways, issued on Tuesday night, shows a loss on the year's working of £820, which is attributed to depression of trade. The number of passengers carried on the system during the year was 1,811,000, being a decrease of 248,000 on the year.

Nottingham.—The Tramways Committee is proposing to construct a double-track tramway from Sneinton Market to Thorneywood Lane, and to make other improvements which it is estimated will cost £23,850. It is proposed that application be made for Parliamentary powers to carry out this work.

Salford.—A Sub-Committee of the Corporation Tramways Committee is considering a proposal which, if adopted, should prove a great boon to those who live on the outskirts of the city. The suggestion, which has been made by the Post Office officials, is that on the late cars running between Whitefield and Peel Green they should be allowed to place boxes for the posting of letters, which can be collected at Deansgate. The Manchester Tramways Committee is considering a similar proposal.

Sheffield.—A deputation of the Tramways Committee, which, with the tramways manager, recently visited various Continental centres to inquire into the rail-less trolley system, recommends that a trial should be made with the system from the tramway terminus at Woodseats to Dronfield. Further routes from tramway termini are also proposed, if the trial should prove successful.

Southampton.—A Sub-Committee has been appointed to consider recommendations by the tramway manager for doing away with a number of short pieces of single track. The manager is of opinion that the revenue account is adversely affected by these by upwards of £2,000 per annum.

South Australia.—In connection with the recent electrification of the Adelaide tramways by the local Tramways Trust, it is interesting to note that the old Adelaide and Suburban (horse) Tramways Co. operated 74 miles of tramways, and carried 11 million passengers in 1901, also that for 27 years it paid regular 7½ per cent. dividends. The contract at present being carried out (and partly completed) comprises 54 miles of city tramways, all of which is expected to be working early in 1910.

Tynemouth-Shields.—The representatives of the Tynemouth and South Shields Corporations have been further considering the question of the electric railway under the Tyne. A deputation waited upon the N.E.R. Co. some days ago, and was very sympathetically received; it is stated that Lord Wenlock, who presided, told the deputation that, subject to the Corporations giving a definite assurance that they would identify themselves with the scheme, the Committee would be prepared to recommend their fellow directors to give a guarantee equal to one-third of the amount required. At the meeting, later, of the representatives of the two Corporations a motion was carried that the two Corporations be recommended to consider the scheme favourably, but that the N.E.R. Co. be asked to guarantee half the interest upon the £100,000, the Corporations to guarantee the other half.

York.—A deadlock recently arose over the ballot which was taken to enable the citizens to decide whether the Corporation or a company should construct and work the local tramways, or whether the routes should be constructed by the Corporation and then leased to a working company. This appears to have been due to a mistake on the ballot paper; however, when the votes were counted an arrangement was decided on, to avoid taking another ballot, and the result of the poll was:—For complete municipalisation, 6,297 votes; for construction and working by a company, 3,734 votes; for the third alternative, only 78 votes. The system will, therefore, be worked by the Corporation.

The report of the Tramways Committee in regard to the adoption of the overhead system was adopted at a meeting of the City Council on Monday. Ald. Mayer said that a surface-contact system would cost something like £20,000 more, and would have to earn more in order to pay. The majority of the Council expressed a preference for the overhead system, and the Corporation was urged to proceed with the work at once.

TELEGRAPH and TELEPHONE NOTES.

Repair of Cables at Messina.—The damage produced by the earthquake and tidal wave on the telegraph and telephone cables has been repaired, some having to be entirely renewed. There are seven cables between the mainland and the island; the one which had to be abandoned was that at the eastern end of the Straits near Cape Gallico. The depth in the Straits is about 500 metres. The effect of the movement was to cover deeply some of the cables on the bed of the Straits, so much so that the powerful machinery available for raising the cables was unable to free them from the super-incumbent earth. It was further noticed on some of the cables which were raised for repair that there were traces of burning, giving rise to the idea that they had been exposed to submarine volcanic eruption. The work was directed by Eng. Brunelli, on behalf of the Italian authorities, and the repair work was carried out by Messrs. Pirelli.—*L'Elettricista.*

South Africa.—Regarding telephonic communication between Kimberley and Bloemfontein, the P.M.G. of Cape Colony recently stated that there was no difficulty between Kimberley and Boshof, but that further experiments were necessary at Bloemfontein; between that place and Boshof only one wire existed, and that was subject to considerable inductive disturbance, and in its present condition could not give a satisfactory service.

Telegraphic Interruptions:—

Port Arthur-Chifu	...	...	...	... March 9, 1904
Pontianak-Saigon	...	...	...	... Sept. 16, 1908
Obock-Djibouti	...	...	...	... April 15, 1909

Wireless Telegraphy.—Writing to the *Times* of April 30th, Mr. G. Marconi refutes certain statements which have been going the round of the Press, alleging that wireless operators suffer injury from working in the neighbourhood of the intense electrical discharges employed in the transmitting apparatus. Mr. Marconi states that during his 12 years' experience neither he nor any of his operators has experienced any ill effects whatever from this cause.

The *Electrical World* (N.Y.) of April 22nd prints a list of the 57 wireless stations maintained by the U.S. Government; of these, no fewer than 11 are in Alaska. On American ships there are 96 stations.

Lieut. E. A. Jeunet, detailed by the Government to install the wireless stations in the Yukon Valley at Nome and at St. Michael, has made a report to the chief signal officer, Department of the Columbia. It has been found that the following power is needed for the several distances named: 125 to 150 miles, 3 KW.; 150 to 200 miles, 5 KW.; 200 to 400 miles, 10 KW.; 400 to 700 miles, 20 KW. The longest distance between any two stations is 781 miles, from Nome to Fort Egbert. Messages have been clearly transmitted between these stations. The five stations installed or completed by Lieut. Jeunet during the summer, after being put in full working order, cost the Government a total of $113,079. From a commercial standpoint the stations are doing better than expected, and the fact that service is never interrupted makes the wireless telegraph an important factor in the development of the north.—*Railway and Engineering Review.*

A special wireless service was provided for the German Emperor on his arrival at Corfu, the latest news being sent from Vienna to Pola, and thence by radio-telegraphy to Corfu. The naval wireless station at Pola has a mast 170 ft. high and a sea range of 1,000 km.

Wireless messages have been exchanged between New York and Chicago, 10,000 miles distant.

The Dominion Government has given instructions that from April 1st the universal alphabet only is to be used. Difficulties, as was natural, have arisen when communicating with vessels employing the American Morse code.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—May 31st. Two 4,700-K.V.A. turbo-alternators, with condensing plant, &c., and one 447-K.V.A. ditto, for the Council's electricity supply department. See "Official Notices" March 12th.

VICTORIA.—50 coin attachments for the P.M.G. See "Official Notices" to-day.

VICTORIA.—Eight sections of common battery switchboard and subscribers' apparatus for Hawthorn Exchange. See "Official Notices" to-day.

MELBOURNE.—May 25th. 1,125,000 flame, and 70,000 ordinary arc lamp carbons for the City Council. See "Official Notices" to-day.

MELBOURNE.—July 14th. One direct-current steam-driven generating set for the City Council. See "Official Notices" to-day.

QUEENSLAND.—Telephone material for the P.M.G.'s department. See "Official Notices" to-day.

Austria.—June 1st. The Austrian State Railway authorities (Northern Section) in Vienna. Three electric travelling cranes.

Bristol.—May 28th. Arc lamp globes; clinker, ashes, &c.; painting and tarring work at Avonbank, for the Electricity Committee.

France.—May 13th. The French Post and Telegraph authorities in Paris (103, Rue de Grenelle). Large quantity of telephone cables, with 14 and 27 pairs of lead-covered conductors.

Hertford.—May 8th. 25-B.H.P. electric motor and gearing, for the Corporation. See "Official Notices" April 23rd.

Holland.—May 24th. The municipal authorities of Bois le Duc require tenders for a complete installation to provide electric lighting and motor power at a new abattoir to be erected shortly. The Town Secretariat.

Kingston-upon-Hull.—May 17th. Air-space telephone cable and telephone instruments, for the Council. See "Official Notices" to-day.

Leyton.—The Electrical Co. having refused to accept the conditions specified as to the cost of carbons for the Blondel arc lamps they offered for trial, the electrical engineer is to draw up a specification of the requirements for proposed new flame arc lamps and send it to the several arc lamp makers asking them to tender and submit a sample series on approval.

Tenders are to be invited for the supply of coal to the generating station.

London.—CHELSEA.—May 12th. Electric light fittings, furniture, &c., for the Town Hall Extension rooms. Particulars from the Borough Surveyor, Town Hall.

ST. PANCRAS.—July 10th Arc lamp carbons for the B.C. See "Official Notices" April 30th.

Manchester.—The Tramways Committee has just invited tenders for a 40-45 H.P. petrol-motor chassis for use as a motor-tower wagon in connection with the maintenance of overhead conductors.

May 18th.—Main switchboard, distribution boards, tramway rails, tie-bars, trolley wire, and rail bonds, for the Corporation. See "Official Notices" to-day.

Mexborough.—June 8th. 100-KW. engine and generator, switchboard extensions, piping, and water purifier and softener for the U.D.C. electricity works. See "Official Notices" to-day.

Nottingham.—May 20th. Coal for the Corporation electricity works.

Rawtenstall.—May 11th. The Corporation invites tenders for a complete electric light installation at the tramcar depôt and municipal offices, Bacup Road, Rawtenstall.

South Africa.—CAPE TOWN.—The tender of the Corporation for the street lighting of Green Point and Sea Point has been accepted by the Municipality. In consideration of an annual payment of £1,375 or £1,475, the Corporation offers to provide 50 arc lamps of approximately 1,350 C.P. for lighting the Main and Beach Roads, together with 100 other lamps, of either 50 or 100 C.P., as may be selected, for lighting the side streets; the whole of the lamps to burn for not more than 2,240 hours during each year. Tenders for the supply of the necessary lamps, posts, cable, wire, &c., are to be called for by the London agents of the Corporation.

PRETORIA.—It is reported in the local Press that, in view of the success of experiments in smelting Transvaal iron at Pretoria C.S.A.R. Works, the Government have decided to erect an electrical furnace at Pretoria, and have requested Sir Richard Solomon, Agent-General in London, to call for tenders for a 3-ton furnace, capable of turning out 6 tons of steel per 24 hours.

KRUGERSDORP.—According to *African Engineering*, the Krugersdorp Municipality requires a quantity of electrical plant for its power station.

Southampton.—Owing to the present low price of copper, tenders are to be invited by the Town Council for the supply of heavy cable for trunk main purposes, the delivery to be made in June, 1910. The Borough Electrical Engineer is to furnish alternative estimates (1) for the supply and erection by Messrs. Babcock & Wilcox of a boiler of 5,232 sq. ft. heating surface, which will be identical in size with the last boiler purchased from the same firm; and (2) for the erection of a new boiler by the staff, using such parts from the existing boiler as are available.

Spain.—May 29th. The City Council of Olot, in the province of Gerona, requires tenders for the public electric lighting for 12 years. A subvention of 13,500 pesetas per year will be paid. A deposit of 750 pesetas, to be raised to 3,000 on acceptance of contract, is required.

The municipal authorities of Castellon have just invited tenders for the concession for the electric lighting of the town.

Whitehaven.—The contract for feeder-pillar castings for the Electricity Department is now closed.

Wigan.—May 17th. 750-KW. engine and generator, two water-tube boilers, piping, economisers, coal-handling plant, cables, switchboard, constructional steel-work, also removal of plant from Pemberton generating station to Wigan, for the Corporation. See "Official Notices" April 30th.

Woodbridge.—June 1st. The U.D.C. wants to hear from a company that would establish electric light works in its district, and light the streets electrically. See "Official Notices" March 26th.

CLOSED.

Bridlington.—The T.C. has accepted the tender of Messrs. Waring & Gillow, Ltd., Manchester, for a scheme of electrical illumination on the Royal Prince's Parade, at £540.

Brighouse.—The T.C. on the 28th ult. resolved to accept tenders from the Phœnix Dynamo Co., W. T. Glover & Co., the Edison Swan Co., and H. Morris & Bastert, Ltd., for supplying apparatus for the new transforming station.

Burnley.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for electric motors up to and including 4 H.P.; also that of Messrs. Dick, Kerr & Co., Ltd., for electric motors from and including 5 H.P. up to and including 20 H.P., and that of Messrs. Ferranti, Ltd., for starters. The British Insulated & Helsby Cables, Ltd., are to supply 600 yards of ·1 sq. in. cable and 300 yards of ·05 sq. in. cable.

Darlington.—On Thursday last week the Corporation Electricity and Light Railways Committee met representatives of the Brush Electrical Engineering Co., Belliss & Morcom, the Westinghouse Co., and Siemens Bros., in connection with their tenders for a 500-KW. electric generator driven by an exhaust-steam turbine. The prices of these tenders have already been published (see the ELECTRICAL REVIEW, April 23rd). It is understood that the borough electrical engineer (Mr. J. R. P. Lunn) does not favour the acceptance of the lowest tender submitted, and that, as the one recommended is about £600 higher, the Committee—as a result of a further meeting—have decided to submit the tenders and designs to Prof. Kennedy for his report.

Dartford.—The U.D.C. has accepted the tender of Messrs. Johnson & Phillips, Ltd., for feeder cable, at £351.

Douglas (Isle of Man).—The T.C. has accepted the tender of Messrs. Walter Scott, Ltd., Leeds, for 25 tons of tram rails, at £7 10s. per ton.

Eastbourne.—The T.C. has accepted the tender of Ferranti, Ltd., for 100 meters.

Gloucester.—The T.C. has accepted the tender of Messrs. Crompton & Co., Ltd., for Conradty carbons for a year, at £105.

Kingston-on-Thames.—The T.C. has accepted the tender of Messrs. Siemens Bros. & Co., Ltd., for a ¼ mile of ·1 sq. in. cable, at £95, and 10-ampere cable, at £35.

L.B. & S.C. Railway.—The tenders of Mr. H. J. Godfrey, of Balham, have been accepted by the L.B. & S.C. Railway Co. for installations at the locomotive department, Brighton, and at the offices and cab-yard, also wiring to elevators, at Clapham Junction.

London.—BERMONDSEY.—The B.C. has accepted the tenders of Messrs. Ferranti, Ltd., for meters, indicators, switches and fuses, of the General Electric Co., Ltd., for two-rate meters and time switches, cut-outs, fuses, &c., and of Messrs. W. Geipel & Co. for arc lamp carbons, at 6s. per 100 pairs.

Nottingham.—The Corporation has just placed an order for two 400-KW. reciprocating engines with Messrs. Willans and Robinson, Ltd. The engines are to be direct coupled to direct-current dynamos built by Messrs. Siemens Bros.

Poplar.—The B.C. has received the following tenders for hot-well tanks required for the electricity undertaking:—

Fraser & Fraser	(accepted)	£48	J. Wilson & Co.		£62
Durham Bros.		50	W. Boby		65
H. Edie & Co.		63	J. Wilson & Co.		68

Salford.—The T.C. has accepted the following tenders:—

Maintenance of electric fans at the London Street and Seedley Council Schools, at 18s. per fan per quarter.—Matthews & Yates.
Annual supplies of meters.—Ferranti, Ltd., Chamberlain & Hookham, Ltd., General Electric Co., Reason Manufacturing Co.
Annual supplies of arc lamp carbons.—Sirius Werke (Baden).
Annual supplies of bitumen.—British Electrical Trades Supply & Bitumen Co.

St. Helens.—The Corporation has recently placed an order for low level jet condensing plant with Messrs. Willans and Robinson, Ltd.

Wrexham.—The T.C. has accepted the following tenders:

Lancashire Dynamo Co.—Part of 120 KW. machine, £220.
British Insulated & Helsby Cables, Ltd.—Pillar box complete, £70.
Willans & Robinson.—Automatic expansion gear, £105.
E. Green & Sons, Ltd.—Economisers, £163.

CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABER (Ogmore Vale).—Elementary school (£3,650); T. M. Franklen, clerk to the Glam. C.C., Westgate Street, Cardiff.

ABERAVON.—Alterations to workmen's club; F. B. Smith, architect, Port Talbot.

ABERBARGOED (Mon.).—New Duffryn Hotel; G. Kenshole, architect, Aberbargoed.

ABERDEEN.—Alterations to 33-35, Union Street; Wilson & Walker, architects, 181A, Union Street. Latrines at provision factory, North Esplanade; Brown & Watt, architects, 17, Union Terrace. Alterations to 57-59, St. Nicholas Street; Brown & Watt, architects. Reconstruction of 28-29, Adelphi; J. Rust, architect, 224, Union Street. Hall at Esplanade; J. Rust, architect. Alterations to 1, Menzies Road; Cameron & Watt, architects, 381, Union Street. Premises in Flourmill Rise; Wilson & Walker, architects. Additions to Donside Paper Mills; A. H. L. Mackinnon, architect, 245, Union Street. Alterations to 9, Chapel Street; H. Mennie, architect, 211, Union Street. Alterations to 33-34, Union Terrace; J. Rust, architect. Granite polishing mill, &c., for A. G. Cheyne, granite merchant. Additions for J. Davidson, fish curer; H. Mennie, architect. Alterations for J. Mitchell, hotel-keeper; Wilson & Walker, architects. Alterations and additions for R. Sinclair, fish curer; W. Stewart, builder.

ABERDEENSHIRE.—Alterations on church buildings at Auchindoir; G. B. Mitchell, architect, 148, Union Street, Aberdeen. Alterations and additions on Pitfour Estate; J. Watt, architect, 26, Marischal Street, Peterhead.

ABERGAVENNY.—Aisle and vestry at Holy Trinity Church; E. A. Johnson, architect, St. Mary's Chambers, Abergavenny. Three villas; J. Mann, jun., architect, Merthyr Tydfil.

ABERTRIDWR.—Elementary school; Clerk to the Glamorgan C.C., Cardiff.

ALSAGER.—Sewerage scheme contemplated; Council surveyor, Alsager.

ASHINGTON.—Additions to the isolation hospital, near North Seaton Station; A. Wood, surveyor, U.D.C. Offices, Ashington.

ASHTON-UNDER-LYNE.—New infants' school.

BALLASALLA (Isle of Man).—Church institute; Rigby & Heslop, architects, Douglas; J. Cooper, builder.

BARNSLEY.—Business premises, Market Street, for the British Co-operative Society; skating rink, Peel Street and York Street, for the Barnsley Roller Skating Rink Syndicate; additions to brewery, for the Barnsley Brewery Co.

BAXENDEN.—New sheds at Alliance Mill; W. Tattersall, architect, The Lindens, Haslingden.

BEDFORD.—Alterations to premises, 2, Honey Hill Road, for C. Melcombe and Son, builders, 14, Castle Road; studio, Bower Street, for T. Minney; re-building premises, 8 and 10, Mill Street, for J. A. Burt.

BELVEDERE.—Methodist Church; Davison & Co., architects, Pearl Buildings, Newcastle-on-Tyne.

BEXHILL-ON-SEA.—Colonnade and bandstand, for the T.C. (£3,193); General Iron Foundry Co., Upper Thames Street, E.C.

BIRMINGHAM.—R.C. Church School; Rev. M. O'Hagan, 524, Stratford Road, Birmingham.

BISHOP'S CASTLE.—Sewerage scheme for the T.C. (£4,600); Wilcox and Raikes, engineers, Birmingham.

BLACKBURN.—New St. Bartholomew's Church at Ewood.

BODMIN.—Cottage Hospital, for the East Cornwall Hospital (£2,000); H. D. Foster, hon. secretary.

BOGNOR.—Sunday school and institutional buildings in connection with the Congregational Church; Rev. W. T. Hailstone, pastor. Six shops, Station Road; Norden & Son, Bognor.

BOLSOVER.—Proposed new offices for the U.D.C. (£1,000).

BOLTON.—Extensions at Duncan Street generating station; A. A. Day, borough electrical engineer.

BOURNEMOUTH.—House, Christchurch Road; Creek, Gifford & Oakley, architects, Hinton Chambers, Bournemouth.

BRETHERTON (near Preston).—New church at Croston.

BRIDLINGTON.—Residence, with stables, garage, &c., Marine Drive, for Mrs. Piercy; H. Phillips, architect, Alexandra Buildings, Scale Lane, Hull. Shelter, lavatories, &c., Hilderthorpe (£2,000 to £3,000), for the New Spa Co.; proposed improvements, including new organ, at the United Methodist Church.

BRIGHTON.—Residence; R. Halls, architect, Severing Chambers, High Street, Lewes.

BRISTOL.—Alterations to business premises, for Gardiner, Sons & Co., ironmongers, Nelson Street.

BROMLEY.—Addition to laundry, Farwig Lane; F. G. Crickett. Post office in East Street, for H.M. Office of Works, Storey's Gate, S.W. Additions Burnham Lodge, Lake Avenue; T. D. Graty, builder, 21, East Street, Bromley.

BRYNMAWR.—Post office and telephone exchange; W. H. D. Caple, architect, Church Street Chambers, Cardiff.

BRYNMENYN.—Elementary school; Clerk to the Glam. C.C., Cardiff.

BURNLEY.—New North Street baths (electric light decided upon); Mr. Pickles, borough surveyor, Town Hall. New temperance hall, for Burnley Temperance Society; S. Lund, The Forum, Burnley. Skating rink, Tunstall Street; C. Riley, architect. New vicarage, Briercliffe Road; T. Bell & Son, architects, Burnley.

BURY.—Alterations to premises for Messrs. J. K. Schofields.

CALNE (Wilts).—New Primitive Methodist Church at Goatacre; T. E. S. Pitt, architect, Calne.

CAMBERLEY.—Proposed Wesleyan Church.

CAMBRIDGE.—Additions to 9, Station Road, for C. E. Gray; Astronomical Observatory, Madingley Road, and boiler house, Corn Exchange Street, for the Chancellor of the University of Cambridge; workshops, Devonshire Road, for W. Charter, Devonshire Road.

CARDIFF.—Lock-up shop in Crwys Road; E. W. M. Corbett, architect, Castle Street, Cardiff. Four houses in Kimberley Road, for Williams & Hoare; W. G. Young, architect, Cardiff. Garage in Bedford Street for R. H. Nash; E. C. Willmott, architect, 107, Richmond Road, Cardiff. Y.M.C.A. Institute at Clydach Street; C. J. Ward, architect, Cardiff. New Y.M.C.A. premises in North Edward Street; Spier & Beavan, architects, Wharton Street, Cardiff. Alterations and extensions to John Cory's Institutes in Wellington Street and Comet Street; W. H. Scott, 74, Stacey Road, Cardiff.

CARLISLE.—Shop, Greystone Road, for Mr. Metcalfe; J. Leslie, architect, Carlisle.

CHESTER.—Proposed enlargement of the Victoria Road Council School.

CHILTON (Sudbury).—Rebuilding of Chilton Lodge after fire (£1,400); M. Gentry, architect, Castle Headingham; Messrs. Deaves, builders, Bures.

CHORLEY.—Proposed new Elementary School; Secretary, Education Committee, Chorley.

CHOPWELL.—Three houses and shops (£1,740); D. M. Spence, architect, Shotley Bridge; J. A. M. Henderson, builder, Jarrow-on-Tyne.

CLACTON-ON-SEA.—Additions to the Isolation Hospital, for the U.D.C.; A. R. Robinson, surveyor.

COTTINGHAM (near Hull).—New offices for the U.D.C.; Gelder & Kitchen, architects, 76, Lowgate, Hull.

COVENTRY.—New hotel, Gosford Park Estate, for Atkinson's, Ltd., Cox Street, Coventry.

CRUMPSALL (near Manchester).—Extensions and alterations at the workhouse; A. J. Murgatroyd, architect, 23, Strutt Street, Manchester.

CWMLAI.—New school (£7,250); Clerk to the Glam. C.C., Cardiff.

DERBY.—Covered fish market; J. Ward, architect, Market Place, Derby.

DEWSBURY.—Skating rink at Batley Carr, for the Empire Skating Rink Co.; P. Robinson, architect, *Yorkshire Post* Chambers, Leeds. New elementary school in Beckett Road, Batley Carr.

DINAS POWIS.—Cookery kitchen at school (£800); Clerk to the Glam. C.C., Cardiff.

DITTON (near Widnes).—Elementary school buildings; H. Littler, architect, Ribblesdale Place, Preston.

DODWORTH (near Barnsley).—New Wesleyan Reform Union Church in connection with Snow Hill Church (£1,000).

DONCASTER.—Probable re-instatement (after fire) of premises at King Foundry, Marsh Gate, for J. C. and T. Yates, agricultural engineers.

DOVER.—School-church, Folkestone Road; Gordon & Gunton, architects.

DUBLIN.—College in Denmark Street; Ashlin & Coleman, 7, Dawson Street, Dublin.

DUMBARTON.—Alterations to premises in High Street, for the Clydesdale Bank, Ltd. Alterations to restaurant, Church Street, for Mrs. A. Sinclair.

DUMFRIES.—Isolation hospital; Hay & Thomson, architects, 10, Bank Street, Dumfries.

DUNDEE.—Additions for T. J. Briarty, Brook Street. Alterations for James Farley, High Street.

EASTBOURNE.—Skating rink, George Hotel, George Row; W. Carr. Additions to factory, St. Michael's Road; Pollard & Son. Additions to Prince of Wales Inn, for the Southdown and East Grinstead Brewery Co., Ltd.

EAST COWES (Isle of Wight).—Reinstatement of premises, after fire, Prince of Wales Hotel, for W. B. Mew, Langton & Co., brewers, Newport.

EASTLEIGH (Hants.).—Twenty-two houses in the Crescent; E. H. White, builder, Eastleigh.

EDINBURGH.—House in Kinnear Road; Edinburgh Academy Boarding House Co. Additions for Merchiston Castle School, Ltd.

ELLON.—Additions to U.F. Church; Wilson & Walker, architects, 181A, Union Street, Aberdeen.

ELTHAM.—Sunday school and mission hall, Elibank Road, for the Building Committee of the "Brethren"; W. H. Smith, architect, 5, Great Winchester Street, London, E.C.

EXETER.—Extensions to Royal Albert Memorial Lodge (£10,000); T. Moulding, architect, Southern Bay, Exeter.

FENTON.—Additions to factory; A. G. H. Jones.

FOLKESTONE.—Re-erection of premises, after fire, High Street, for G. Mence Smith & Co., oil and colourmen, 104, Southwark Street, London, S.E.

FOOT'S CRAY (Kent).—Enlargement, &c., of the public hall; A. E. Leonard, clerk to the U.D.C.

FRIZINGTON (Cumberland).—Extension of the Freemasons' Hall; E. Jackson, civil engineer, Whitehaven.

GATESHEAD.—Church school; Marshall & Tweedy, architects, 17, Eldon Square, Newcastle-on-Tyne.

GILLINGHAM.—Wesleyan Sunday schools, Byron Road; G. E. Bond, architect, 384, High Street, Rochester; H. E. Phillips, builder, Livingstone Road, New Brompton.

GLENISLA (Perthshire).—Additions and alterations at Glenisla House for Sir J. Kinloch.

GOODMAYES (Essex).—Presbyterian Church; Smee & Houchin, architects, Byron House, Fleet Street, E.C.

GOUROCK (N.B.).—Restaurant (£2,000); Tough & Alexander, architects, 2, Hamilton Street, Greenock.

GRIMETHORPE (near Barnsley).—Eighteen houses, for the Barnsley British Co-operative Society; the Secretary.

GUILDFORD.—New Parish Hall (£3,000), for St. Mary's, Holy Trinity; Rev. E. C. Kirwan, Holy Trinity Vicarage, Guildford.

HALESOWEN.—Congregational Sunday Schools (£2,500); A. L. Butler, architect, Cradley Heath; Hadley & Sons, builders, Old Hill, Staffs.

HALIFAX.—New Liberal Club, Moorside, Ovenden; L. Coates, architect, 10, Central Street, Halifax. Alterations to Raglan Street Dyeworks, for Fletcher Bros.; C. F. L. Horsfall & Son, architects, Lord Street Chambers, Halifax. Proposed new church at King Cross; Sir C. Nicholson, Bart., architect, 2, New Square, Lincoln's Inn, W.C.

HANLEY.—Sunday school; W. Campbell, architect, 2, Bagnall Street, Hanley.

HARPENDEN.—Additions to Harpenden Lodge, for R. Lydekker; houses, Coldharbour Lane, for the trustees of the Oddfellows' Society.

HARROGATE.—New church at Starbeck; Rev. D. S. Guy, vicar of Christ Church, Harrogate. Proposed abattoir and bacon-curing factory, Starbeck, for Oliver Bros., 17, Market Place. Additions to Park House, 21, Park Parade, for Mrs. Brooksbank. Alterations to bank premises, Cambridge Street, for Becket & Co., 6, Cambridge Crescent. Shop and house, Alderson Road, for Lison & Harris.

HASLINGDEN.—Skating rink; W. Tattersall, architect, The Lindens, Haslingden. Tramway offices for the T.C. (£400).

HASLINGTON (near Crewe).—New chancel, vestry, &c., at the Church; T. R. Longden, architect, Market Place, Ruralem.

HASTINGS.—Rebuilding of the Town Hall under consideration.

HATHERSAGE (near Sheffield).—Bank premises for Crompton & Evans' Bank, Ltd.; J. S. Dalton, builder, Hathersage.

HECKMONDWIKE.—New Sunday Schools in connection with the parish church.

HETTON-LE-HOLE (Co. Durham).—House and shop, Richard Street, for J. Speed. Re-building Cross House Inn, Basington Lane, for Black and Corballis.

HEMSWORTH COLLIERIES (near Wakefield).—Athletic club buildings for the South Kirby, Featherstone and Hemsworth Collieries, Ltd.; Garside & Pennington, architects, Ropergate House, Pontefract.

HINDLEY.—Infectious diseases hospital; O. Abbott, Hindley.

HOLMPTON.—Enlargement and improvement of school; Building Surveyor, East Riding Education Committee, County Hall, Beverley.

HORSELL.—Extensions to the Church (£2,000).

ILFORD.—Prospective rebuilding, after fire, of the G.E. Railway sheds at Ilford Station.

KINGSTON-ON-THAMES.—Additions to St. Paul's Church; F. Peck, architect, 24, Old Queen Street, Westminster, S.W.

LEEDS.—Proposed Agricultural Hall on the North Street Recreation Ground; Chairman, Leeds Smithfield Club.

LEICESTER.—Probable re-instatement, after fire, of premises, Crafton Street, for J. Bevins, fancy hosiery manufacturer; and St. James's Street, for T. H. Lloyd & Co., manufacturing chemists.

LEITH.—Flats and self-contained villas at Blackie Road, for Leslie & Milne, builders.

LESLIE (Fife).—Additions to Drill Hall (£400); Major Gillespie, secretary, Territorial Association, Cupar.

LICHFIELD.—Proposed new church schools (£2,400).

LINDLEY (Yorks.).—Two shops and houses, Lidget Street; Fred. Dyson, 25, Lidget Street.

LIVERPOOL.—Hospital building (£15,000); H. & D. Fry, architects, 18, Hackins Hey, Liverpool. New branch in Great Charlotte Street, for the North and South Wales Banking Co.; Haugh & Piling, contractors, Liverpool. Rebuilding business premises, 10, Dale Street, for Mr. Klindworth.

LLANWDDYN (Montgomeryshire).—Place of worship at Cowni; J. M. Humphreys, Brynawel.

LLANRHIDIAN.—Elementary school; Clerk to the Glam. C.C., Cardiff.

LLANTWIT MAJOR (near Cardiff).—Re-erection, after fire, of business premises, for Rees, Morgan & Co., ironmongers (damage, between £4,000 and £5,000).

LLWYNYPIA.—Thirty houses at Pont Rhondda; W. Morgan Lewis and T. Naunton Morgan, architects, Tonypandy.

LONDON (Tooting, S.W.).—Mission Hall in Mitcham and Longmead Roads, for the Trustees of the Tooting Wesleyan Mission. Sixty houses in Derinton Road, 10 in Church Lane, 26 in Lessingham Avenue, and 16 in Okeburn Road; Rowley Bros. Building in Church Lane, for R. Cox.

(South Kensington, S.W.).—Repairs (after fire) at the chemistry department at the Central Technical College, Exhibition Road.

(W.).—Extension to premises of Lewis & Allenby, Ltd., Regent Street and Conduit Street; F. T. Verity, architect, 7, Sackville Street, W.

(S.E.).—Alteration to Camberwell Palace of Varieties, Denmark Hill; F. Matcham & Co., architects, 9, Warwick Court, High Holborn, W.C.

(Shoreditch, N.E.).—Workshops at 18A, Drysdale Street. Workshop at 18, Salisbury Street.

(W.).—Alterations, 38, Albemarle Street; J. Lenn & Co., builders, 289, High Street, Camden Town, N.W.

(E.C.).—Factory, St. John Street; W. H. Woodroffe, architect, 57, Lincoln's Inn, W.C.

(W.).—Offices, factory, &c., on site of 24 and 26, Maddox Street; T. H. Kingerlee & Sons, builders, Oxford and Shepherd's Bush, W.

(Streatham, S.W.).—Telephone exchange, corner of Streatham High Road and Ena Road; Bromley & Watkins.

(Barking, E.).—Proposed Wesleyan Hall (£5,000).

(Kensington, W.).—Buildings at premises of the National Motor Cab Co., Ltd., Barlby Road; E. K. Purchase, architect, 20, Maddox Street, Regent Street, W.

(Paddington, W.).—Building at rear of 90, Kensal Road, for Wiltshire United Dairies, Ltd.; W. B. Medlicott, architect, 11, Hart Street, W.C.

(Stepney, E.).—Workshop at rear of 125-129, Duckett Street; H. Summers.

(Lewisham, S.E.).—Proposed Roman Catholic school at 173, High Street (150 children).

(Islington, N.).—Addition to 347, Liverpool Road; R. Midworth, architect, Bank Chambers, Station Road, Finsbury Park, N.

(Marylebone, W.).—Building in Dean's Mews, for the Belsize Motors London Agency, Ltd., Dean's Yard, Cavendish Square, W.

(Bromley-by-Bow, E.).—Addition to Red House School, Love Lane; Holman & Goodrham, architects, 6, King's Bench Walk, Temple, E.C.

(Poplar, E.).—Building in Old Ford Road, for the B.C.; H. Heckford, Council surveyor.

(Woolwich, S.E.).—Buildings in Herbert Road and Plumstead Common Road, for the B.C.; J. R. Dixon, Council's surveyor.

(Herne Hill, S.E.).—Five houses in Norwood Road; May & Perrin.

(Deptford, S.E.).—Library in New Cross Road; J. Sutcliffe, surveyor to the B.C.

(Bermondsey, S.E.).—Buildings on site of 117–123A, Grange Road; G. Elkington & Son, architects, 7, Laurence Pountney Hill, E.C.

(Battersea, S.W.).—Addition to works of Garton, Hill & Co., York Place, York Road.

(St. Pancras, N.W.).—Rebuilding Trinity Presbyterian Church, Buck Street, Kentish Town Road; G. Leithbridge, architect, 7, Drapers Gardens, E.C.

(Kingsland, N.E.).—Conversion of 105, Kingsland High Street into Palace of Animated Varieties (accommodate 360); A. Ludski.

(Upper Edmonton, N.).—Transformer house, coal store, and other buildings at the workhouse; S. Hill, architect, 105 Cannon Street, E.C.

(Leyton, N.E.).—Addition to "Northcote" public-house, Grove Green Road; P. Cornish, architect, 641, High Road, Leytonstone.

(Walthamstow, N.E.).—Five houses, Milton Road; H. Brodey, architect, 259, High Street, Walthamstow.

(Chelsea, S.W.).—Re-erection of 394-400, King's Road; Elms & Jupp, architects, 25, Sackville Street, W.C.

(Lambeth, S.E.).—Additions to Summerstown Mission Hall, Blackshaw Road, for the Trustees.

(Putney, S.W.).—Additions to Hospital for Incurables (£5,415); R. L. Hesketh, architect, 110, Cheapside, E.C.; F. G. Minter, builder, High Street, Putney.

(Wood Green, N.).—County school (£11,037); Mattock Bros., builders, Wood Green, N.

LUDLOW (Salop).—Secondary School; H. Brakspear, architect, Corsham (Wilts).

LUTON.—Probable re-instatement, after fire, of premises, Bute Street, for C. H. Osborne, J.P.

LYNTON.—Motor garage and stables at the Castle Hotel, for T. Jones. Enlargement of the elementary schools, for the Education Committee; Taylor & Cowell, contractors. Catholic Convent; B. Jones, builder, Lynton.

MAGOR (Mon.).—New Council school (100 children); C. Dauncey, secretary, County Education Authority, Newport.

MANSFIELD.—Memorial Hall, Portland Street, for the Vicar of St. Mark's.

MARGATE.—Two houses and shops, Northdown Road, and additions to Godwin College; Reeve & Reeve, architects, Margate.

MILFORD HAVEN.—New chapel, school rooms, &c.; D. E. Thomas & Son, 17, Victoria Place, Haverfordwest. Shop, and alterations and additions to stores (£700); C. L. Blethyn, architect, Milford Haven; Hayward and Wooster, builders, Bath.

MINWORTH (near Birmingham).—Mission Church.

MONEA.—Roman Catholic Convent; W. A. Scott, architect, 45, Mountjoy Square, Dublin.

NEATH ABBEY.—Alterations to school (£400); Clerk to the Glam. C.C., Cardiff.

NEWCASTLE-ON-TYNE.—Enlargement of Gosforth Parish Church; Hicks and Charlewood, architects, 67, Westgate Road, Newcastle. Twenty shops and hall; Simpson, Lawson & Rayne, architects, Emerson Chambers, Newcastle-on-Tyne.

NORTHAMPTON.—Skating rink, Wellingborough Road, for the Empress Skating Rink Co. Rebuilding "Sportman's Arms," Bath Street, and alterations to "Durham Ox" public-house, Augustin Street; P. Phipps & Co., Ltd.

NOTTINGHAM.—Institute (£5,000); A. E. Lambert, architect, 22, Park Row, Nottingham.

OLDHAM.—New Sunday School in connection with Regent Street Congregational Church (£2,500); Rev. E. R. Butler, pastor.

OSWESTRY.—New Sunday Schools in connection with the English Baptist Church (£600); Rev. J. C. Elder, pastor.

OXENHOLME.—Residence near Barrows Green; T. M. Banks, architect, 14, Finkle Street, Kendal.

PEMBREY (Carmarthenshire).—Residence, &c., for J. W. Bishop; A. S. Williams, architect, Llandilo.

PENLLINE.—New school; clerk to the Glam. C.C., Cardiff.

PENTYRBYL.—New elementary school; T. M. Franklen, clerk to the Glamorgan C.C., Westgate Street, Cardiff.

PENYCRAIG.—Residence, stables, &c., for W. M. Morgan; W. M. Lewis and T. N. Morgan, architects, Dunraven Street, Tonypandy.

POCKLINGTON.—Infants' school (125 places); Building Surveyor, East Riding Education Committee, County Hall, Beverley.

PONTEFRACT.—Conversion of premises, Southgate, into eight houses, for C. W. Addingley, The Beeches; Jas. Haseltine, architect, Old Castle Drawing Office, Pontefract.

PONTYCLUN.—Higher elementary school; clerk to the Glam. C.C., Cardiff.

PONTYPRIDD.—Gymnasium for county school; clerk to the Glam. C.C., Cardiff.

PORTOBELLO.—Tenement and villas, for J. W. Kennedy.

PORTSMOUTH.—Skating rink and pleasure palace, for a new company; J. Murtough, secretary, Town Hall Square, Portsmouth. Additions to Lloyd's Bank premises, 32A, London Road; H. Jones, Broad Street, Portsmouth. House and bakehouse, Beeston Street; E. Nichols, 5, Beeston Street, Landport.

RADCLIFFE (Lancs.).—New premises, for the Y.M.C.A.; Secretary. New day schools, for St. Andrew's, Black Lane.

RADCLIFFE-ON-TRENT.—Extensions to the Asylum, for Notts. C.C.; E. P. Hooley, County Architect.

RAMSEY (Hunts.).—Extensions to schools (£840); J. Saint & Sons, builders, St. Ives, Hunts.

RAWTENSTALL.—Alterations to house and shop, Burnley Road, Waterfoot, for J. Pickup; two villas, Oakenhead Wood, Haslingden Old Road, for Ashworth & Whitaker; alterations and additions to Oakley Manse, for H. M. Kenyon.

REDBRIDGE (Hants.).—Proposed new works, for the London and South-Western Railway Co.

REDHILL.—Elementary school at St. John's, for the Reigate Education Committee; T. R. & W. Hooper, architects, Market Hall, Redhill.

RISHTON (near Blackburn).—House and shop, near Lord Street, for J. Knowles.

ROTHERHAM.—New church at Catcliffe; J. E. Knight, architect, 33, College Street, Rotherham.

ROYSTON.—House and business premises, Midland Road; C. L. McLintock, architect, 28, Church Street, Barnsley.

ROYTON.—Church Institute; E. Woodhouse, architect, 88, Mosley Street, Manchester.

RUABON.—Hall; J. D. Lewis, architect, Talbot Chambers, Shrewsbury.

RUGBY.—Drill hall; J. Liddington, architect, Regent Street, Rugby.

RYEHILL.—Alterations and improvements to school (£545). H. Renardson, builder, Market Hill, Hedon, Hull.

ST. ALBANS.—Hospital; F. Mence, architect, Market Place, St. Albans.

ST. ANDREWS (Fife).—New manse at Boarhills; C. F. Anderson, architect, St. Andrews.

ST. HELENS.—Probable re-erection, after fire, of premises, Cotham Street, for G. Hodson & Co.

SALE.—Renovation, after fire, of R. B. Petterner's Nurseries, Sale.

SANDBACH.—Additions to Wesleyan Church.

SEACOMBE (Cheshire).—Branch tramway offices at Seacombe Ferry; W. H. Travers, District Engineer, Wallasey U.D.C.

SEDBERGH (Yorks.).—Warehouse for P. A. Thomas; E. D. Dennis, architect, Sedbergh.

SHAW (Lancs.).—House and dairy, Lower Rushcroft, for Capt. Crompton; 10 houses, Farrow Street, and 10 in Christine Street, for Gadfield and Heritage.

SHEERNESS.—Mineral water factory, stables, &c., Railway Road, for the Sheerness and District Licensed Victuallers' Mineral Water Co., Ltd.; Wm. Golder, secretary, 49, Alma Street, Sheerness.

SHEFFIELD.—Alterations and improvements at Cemetery Road Congregational Church. Salvation Army Halls (£2,600).

SLAITHWAITE.—Business premises and house, Royd Street; A. Shaw, architect, Knowle Road, Golcar.

SOUTHAMPTON.—Alterations and additions, "St. Katherine's," Clifton Road; Weston & Burnett, architects, 24, Portland Street, Southampton. Additions to Eastern District school (£650); J. A. Crowther, engineer, Southampton Town Council.

SOUTHSEA.—Three shops; J. G. Davis, architect, Cottage Grove, Southsea. Additional block at Nurses' Home; C. W. Bevis, architect, Elmgrove, Southsea.

SPENNYMOOR.—Alterations and additions to Church schools; Clark and Moscrop, architects, Darlington.

STAFFORD.—Wesleyan Church (£1,250); C. W. D. Joynson, architect, Wednesbury; H. Gough & Sons, builders, Wolverhampton.

STALYBRIDGE.—Higher elementary and technical school for the T.C.; G. Rowbottoms, architect, Portland Chambers, Stalybridge.

SUTTON (Surrey).—School, Benhill Avenue; T. Wall, "Blythewood," Sutton.

SWANSEA.—Alterations to Old Swan Hotel, Gower Street, for Mr. Lloyd; twelve houses for Exhibition, for Swansea Corporation; M. Hoskins, estate agent. Six houses, Beechwood Road; R. Lacey, builder. Francis Street, Swansea. Baptist Chapel, Cecil Street and Elgin Street.

TADCASTER.—Thirty houses at Lock Lane; additions to the Roman Catholic School.

TANTOBIE.—Shops, warehouses and stables (£660); D. M. Spence, architect, Shotley Bridge; T. Duffy, builder, Stanley.

TARPORLEY.—Probable re-instatement, after fire, of portion of Tilstone Lodge, residence of C. Threlfall.

TIPTON.—Fifteen houses and premises in Furnace Parade, for F. T. Pitt.

TREHARRIS.—Twenty-five houses at Edwardsville; W. Dowdeswell, architect, Treharris.

TRURO.—Four villas; A. E. Harris, architect, Avondale Terrace, Truro.

TUNBRIDGE WELLS.—Additions to the post office for H.M. Office of Works

UPPER COLWALL (Worcestershire).—Church institute; Parker & Son, architects, 5, Foregate Street, Worcester.

WALTHAM ABBEY.—Salvation Army citadel; H. Oram, builder.

WARRINGTON.—Alterations to premises, Orford Lane and Forster Street, for the Warrington Co-operative Society; additions to salting rooms, &c., Winwick Street, for the Warrington Co-operative Society; skating rink, Wilderspool Causeway, for the Warrington Skating Rink Co.

WATFORD.—Proposed electric light installation at St. Michael and All Angels' Church; Rev. W. H. Littlebury, vicar.

WATTSTOWN.—Institute and gymnasium; B. H. Huxham, architect, Wattstown.

WALKDEN.—Block of houses to be built in Bridgewater Road; E. Warburton, Ellesmere Hotel, Walkden. Surface developments at Ellesmere Colliery, Walkden, for Lord Ellesmere.

WHITEBROOK (near Monmouth).—New Council school; C. Dauncey, secretary, Education Authority.

WHITLEY BAY.—Skating rink; White & Stephenson, architects, 59, Grey Street, Newcastle-on-Tyne.

WIGAN.—New church, Millgate; J. B. and W. Thornley, architects, College Chambers, Library Street, Wigan; J. Wilson & Co., builders, Caroline Street, Wigan.

WILLINGTON QUAY.—Extension of Addison Potter Schools, for Northumberland C.C.; C. Williams, Education Secretary, the Moothall, Newcastle.

WIMBORNE.—Church; Chinchen & Son, architects, Parkstone, Dorset.

WINCHESTER.—Block of 51 office and store rooms, for Hants. C.C.; W. J. Taylor, County Surveyor, The Castle, Winchester.

WITHERNSEA (near Hull).—Skating rink and recreation hall, for the Pleasure Gardens Co., Ltd.; Freeman, Son & Gaskell, architects, 11, Carr Lane, Hull.

WOOLACOMBE (Devon).—New church on site given by Miss Chichester (£6,500); W. D. Caröe, architect to the Ecclesiastical Commissioners.

WORKINGTON.—Probable re-erection, after fire, of Irish National League Hall, New South Watts Street (damage, £1,000).

WORTHING.—Probable re-erection, after fire, of Trafalgar House, Augusta Place; E. Meager, owner, 3, Selden Road, Worthing.

YEOVIL.—Large new offices; J. Petter & P. F. Warren, architects, Union Bank Chambers, Southampton.

YSTRADMYNACH.—School (£3,200); Clerk to the Glam. C.C.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers (Graduates' Association).—Monday, May 10th At 8 p.m. Paper on "Railway Permanent Way," by Mr. H. H. Bird.

Institution of Electrical Engineers (Glasgow Section).—Tuesday, May 11th. At 8 p.m. At 207, Bath Street, Glasgow. Annual general meeting. Paper on "Interpole Designs," by Mr. W. B. Hird.

Institution of Electrical Engineers (Dublin Section).—Thursday, May 13th. At 8 p.m. Meeting at the Royal College of Science.

Institution of Electrical Engineers (London).—Thursday, May 13th. At 8 p.m. At the Royal Society of Arts, W.C. Paper on "Economics of Medium-Sized Power Stations," by Mr. A. J. J. Pfeiffer.

Royal Institution.—Friday, May 14th. At 9 p.m. Discourse on "Solar Vortices and Magnetic Fields," by Prof. G. E. Hale.

Physical Society.—Friday, May 14th. At 8 p.m. At the Imperial College of Science, South Kensington, S.W. Papers on "A Bifilar Vibration Galvanometer," by Mr. W. Duddell; and "Effect of Temperature on the Hysteresis Loss in Iron in a Rotating Field," by Messrs. W. P. Fuller and H. Grace.

Junior Institution of Engineers.—Saturday, May 15th. Visit to the British Thomson-Houston Co.'s works.

THE ELECTRICAL ENGINEERS (LONDON DIVISION).

The following orders are issued for the week ending May 15th, 1909:—

Commanding Officer—Col. R. E. B. Crompton, C.B.

Monday, May 10th.—"A" Company. Infantry drill, 6.45 p.m. Adjutant's drill.

Tuesday, May 11th.—"B" Company. Infantry drill, 6.45 p.m. Adjutant's drill.

Thursday, May 13th.—"C" Company. Infantry drill, 6.45 p.m. Adjutant's drill.

Friday, May 14th.—"D" Company. Infantry drill, 6.45 p.m. Adjutant's drill.

(Signed) J. H. S. Phillips,
Capt. and Acting Adjutant.

X-Ray Dermatitis.—We are pleased to report, on the authority of the *Times*, that Mr. Harry W. Cox is somewhat better. The ulcer on the chin is arrested, and he is able to sleep, and is comparatively free from pain. He has been under radium treatment by the surgeon-in-charge of the electrical department of the London Skin Hospital, Fitzroy Square, and, apparently, the treatment has been a great success.

Appointments Vacant.—Station superintendent for Coventry electricity works (£3 3s.); assistant engineer to take charge of erection and maintenance of overhead equipment of Liverpool Corporation tramways (£250). See our advertisement pages to-day.

NOTES.

Junior Institution of Engineers' Dinner.—On Saturday last the twenty-fifth anniversary dinner of the Junior Institution was held at the Hotel Cecil; the president, Mr. J. Swinburne, F.R.S., was in the chair, supported by many past presidents and other men of note, including the Rt. Hon. R. B. Haldane, F.R.S., Sir W. White, Mr. W. M. Mordey, Mr. A. J. Walter, K.C., Mr. R. Bousfield, K.C., and Mr. J. H. Rosenthal.

After the loyal toasts, Lieut. A. T. Dawson, R.N., proposed "The Territorial Force," remarking that the increase in Germany's naval strength obliged us to look seriously into our home defence and to provide against an unexpected raid in the temporary absence of the fleet. The Territorial Forces now constituted a fully-organised citizen army of defence in large divisions with complete transport and equipment. In his reply Mr. Haldane said that it could never be too often repeated that naval power was the foundation of our defences; science was more potent nowadays than brute force, and the combination of thought and resources gave our only hope of preserving our position in the world. A most prominent problem of defence was how to bring the Navy and Army into close co-operation, and to secure the freedom of the Navy adequate home defence was necessary. The Territorial Force was up to seven-eighths of its war strength, the Regular Army full, and the Special Reserve rapidly filling up; and the great divisions were complete in all arms. A larger expeditionary force was now available than ever before in the history of the country. The most successful feature of the Territorial Force had been the technical element, particularly in the engineering and medical services. Discussing the question whether the forces available now fulfilled the requirements due to foreign naval developments, Mr. Haldane considered three possible cases, given here in brief:—

Sudden invasion by 100,000 men without warning:—
- Expeditionary force, 167,000 men, at home.
- Regular troops, 150,000 men, at home.
- Territorial force, 14 divisions and 14 mounted brigades, at home.

Total = 10 Army Corps.

Invasion 12 months after departure of expeditionary force and fleet to remote part of Empire:—
- Regular troops, 150,000 men, at home.
- Territorial force embodied immediately on departure of expeditionary force (in accordance with the Act of Parliament), and fully trained under arms.

Total = 7 Army Corps.

Invasion two months after departure of expeditionary force:—
- Navy on the alert patrolling the narrow seas to prevent landing of foreign force.
- Regular troops, 150,000 men, at home.
- Territorials embodied and training under arms.

He believed in taking the aggressive, and preferred a very strong Navy to universal military service for this and other reasons; let them concentrate their energies on a Navy which should command the seas, and an expeditionary force of the finest quality.

Mr. Swinburne proposed "Invention," in a speech full of humour, pointing out the absurdities of the existing procedure in connection with the filing and working of patents for inventions, and with the trial of law cases relating to infringements. The only feature in the matter that was not humorous was the costs; the poor inventor's point of view was always ignored.

In reply, Mr. W. T. Clark (President of the Chartered Institution of Patent Agents) attacked Sec. 27 of the Act of 1907, and urged that a longer period of protection was required for the inventor, who was not sufficiently encouraged in this country. In the United States the term was 17 years net, while here the effective term was only 12½ or 13 years, and heavy renewal fees fell due before the inventor had had time to develop his invention. Mr. A. J. Walter, K.C., also replied, pointing out that we could not keep pace with our competitors without invention, which was supported by foreign but not by British Governments. The new provision for the revocation of patents had been misinterpreted; if a man took out a patent in this country only, and it was free and worked abroad, anyone could get the patent revoked, no matter how the inventor developed the manufacture at home. Another Act would be necessary to restore the rights of the patentee. Nearly every petition for revocation had been presented by a German who wanted the patent revoked in order to facilitate importation. Touching patent litigation, it was the duty of an expert witness to present his client's case in the best light—not to constitute himself the judge; the existing system of patent trials was, in his opinion, the soundest.

Mr. W. M. Mordey, President I.E.E., proposed the "Junior Institution of Engineers," which he had heard was the most alive of all the engineering institutions in London. He said that this country was leading the world in engineering progress and education. Mr. G. T. Bulloch, vice-chairman J.I.E., in his reply, referred to the regretted absence of the chairman, Mr. Durham, through illness, and stated that the membership was now over 1,000, and they had founded a building fund.

Mr. B. E. D. Kilburn proposed "The President," who, in his reply, toasted the secretary, Mr. W. T. Dunn; the latter replied briefly.

The proceedings were enlivened with an excellent musical programme, and were continued to a late hour.

National Electrical Manufacturers' Association (Incorporated).—A Committee meeting of this Association will be held at Balfour House, Finsbury Pavement, E.C., on Monday, May 10th, at 2 p.m.

The International Candle.—It has been common knowledge in official circles for some time past that an international agreement between the United States, France and this country for the unification of their standards of candle power has been approaching settlement, and the *Electrical World* of New York announces that the American authorities have accepted the proposals put forward by the Bureau of Standards to that end. It will be remembered that the question was raised at the meeting of the International Electrotechnical Commission in London last year by the French Committee, but the matter was not then ripe for settlement, owing, we believe, to some ambiguity in connection with the determination of the humidity of the atmosphere in the course of our National Physical Laboratory experiments. According to our contemporary, the American authorities are willing to reduce their standard by 1·6 per cent. to bring it into agreement with the French and British values; the French standard will be unchanged, and the British standard will need only a slight modification of the specification for the pentane standard with regard to the measurement of humidity. There will remain besides only the German standard Hefner unit, which will be $\frac{9}{10}$ of the international standard, a convenient numerical relation. It is to be hoped that an agreement on these lines will shortly be concluded.

Electricity in Laundries.—One of the papers read at a recent conference under the auspices of the Scottish Laundry Association in Glasgow dealt with "Electricity as Applied to Laundries," and was contributed by Mr. B. W. Gilmour, of Glencairn Laundry, Motherwell. He said that electricity as a motive power was not so cheap for laundries as steam, because of the large quantity of steam required in a laundry for heating and boiling purposes, which affected the relative costs. On installing motors they would have to use live steam for drying and heating in place of exhaust steam. The advantages of electricity were reduction of the dust, simplicity of starting and stopping the machinery, and smallness of the space occupied, while they would get a more steady drive from motors. There was only one department in which electricity as a heating power could be applied to laundries, and that was in hand ironing. The extra cost over gas was so little that it was not worth considering, while electricity had the advantages of cleanliness, concentration of heat on the required part, and absence of smell. From his experience, electric light might cost more than gas, but if the wiring was properly executed, there was less danger of fire, and it was easier to light up.

Electrical Football League.—The annual general meeting of the League will take place at 7 p.m. on Wednesday, May 19th, in the offices of the St. James's and Pall Mall Electric Light Co., Ltd., 19, Carnaby Street, Golden Square, W. Representatives of clubs wishing to join should attend this meeting. The past season has been a very successful one, and it is hoped to make next season even more so by introducing new clubs. The hon. secretary, Mr. J. W. Fraser, will be only too pleased to give any information required on application to him at 39, Wearside Road, Lewisham, S.E.

Name of club.	Played.	Won.	Lost.	Drawn.	Goals. For	Agst.	Points.
Metropolitan Electric F.C.	12	11	—	1	49	7	23
County of London ,, ,,	12	8	3	1	24	9	17
St. Pancras ,, ,,	11	5	3	3	35	17	13
Robertson's ,, ,,	11	4	6	1	22	25	9
General ,, ,,	12	3	6	3	19	22	9
St. James' ,, ,,	12	3	6	3	13	33	9
Ediswan ,, ,,	12	—	10	2	5	55	2

Fatalities.—On Sunday night three persons lost their lives by electric shock in Paris. On the Circular Railway, near Saint Ouen, there is a spot where a number of high-pressure conductors are carried along a bank; a boy, eight years old, was trespassing at this spot when he slipped down the incline against the wires, and was instantly killed. A young workman named Henri Voyet went to the rescue, but directly he touched the boy, he received a shock and fell upon the wires, holding the body in his arms. Another workman, named J. M. B. Millet, heroically endeavoured to rescue the two victims, but he also received a shock, and died shortly afterwards. In the meantime the current was cut off, and on the arrival of the firemen and police the bodies were removed; they will be buried at the expense of the city.

Sir Christopher Furness and Co-partnery.—The *Times* says that Sir Christopher Furness and two other gentlemen have acquired the Wingate Colliery, Durham, and the estate. Sir Christopher has asked the employés, numbering 15,000, to meet him on the 31st inst., when he will submit a scheme of working for obtaining more beneficial results to workmen and employers. It is understood that he intends to establish the co-partnery scheme at the colliery.

Institution and Lecture Notes.—Scottish Tramway Officials' Association.—Recently a meeting of this Association was held in Motherwell, when Mr. Moller, the manager of the Lanarkshire tramways, read a paper on that company's experience of carrying its own third party risks. We understand that the paper went a long way to prove that with a thoroughly organised system of reporting, investigating and dealing with accidents, a considerable saving is made, against handing over this class of business to an insurance company. After inspection of the power house and the repairing shops, the party were entertained to lunch by Mr. Moller. They afterwards inspected some of the track, which proved interesting on account of the great subsidences brought about by the coal mining in the Motherwell district. The next meeting of the Association is fixed for May 21st, when the members will, on the invitation of Mr. Pilcher, of Aberdeen, and Mr. Wilkie, of the Aberdeen Suburban, visit that city.

North-East Coast Institution of Engineers and Shipbuilders.—On May 1st the address of the Institution was altered to Bolbec Hall, Westgate Road, Newcastle-upon-Tyne.

Institution of Electrical Engineers (Birmingham).—The report of the Committee presented to the annual general meeting on Wednesday last showed that the membership amounted to 330, as compared with 342 a year ago. The following office-holders for 1909-10 were elected:—*Chairman*, R. K. Morcom; *Past Chairmen*, R. Threlfall, R. A. Chattock, Gisbert Kapp; *Vice-Chairman*, M. Railing; *Committee*, J. H. Barker, V. Bornand, A. R. Everest, A. Lindsay Forster, J. P. Kemp, Dr. M. Kloss, Col. J. F. Lister, F. J. Moffett, A. Pearson, W. E. Sumpner, D.Sc., A. M. Taylor, J. C. Vaudrey; *Hon. Secretary*, H. B. Matthews.

Physical Society of London.—At the meeting on April 23rd, a paper by Prof. W. H. Bragg and Mr. J. L. Glasson, on "A Want of Symmetry shown by Secondary X-Rays," was read by Prof. Bragg, and one entitled "Transformations of X-Rays" was read by Mr. C. A. Sadler. A paper on the "Theory of the Alternate-Current Generator," by Prof. Lyle, was read by Dr. Russell. The author pointed out that the theory of armature reaction as ordinarily discussed by electricians is unsatisfactory, as an important effect due to the mutual induction between the current in the field winding and the current in the armature circuit is neglected. The action of "dampers" in diminishing the heat losses in the field circuit and the theory of the synchronous motor were also discussed. Dr. Russell said that the effect of the reaction on the wave-form of the machine had been practically neglected, and Prof. Lyle deserved great credit for his solution. In connection with the parallel running of turbo-alternators it was important, and the theory deserved careful study by engineers. Prof. L. R. Wilberforce exhibited a galvanometer of the Broca pattern suitable for general use in elementary laboratories.

Institution of Electrical Engineers (Dublin).—The Dublin Local Section held a smoking concert at the Gresham Hotel, on Friday last, Mr. G. F. Pilditch, chairman of the Section, presiding. The hall was filled with members and their guests; a first-class vocal and instrumental programme had been arranged, and a most enjoyable evening was the result.

Changing Meters.—It is, perhaps, a fact that need not be too freely advertised, that electricity meters do occasionally go wrong and require replacement. If the error is on the fast side, the earliest indication will probably be a strong appeal from the consumer urging the supply authority not to be so devoid of conscience. If, on the other hand, the meter is running slow, the householder will probably remain in blissful ignorance till further orders, unless the meter department discovers that the consumption of electricity has gone down as compared with the similar quarter in the previous year, without adequate cause.

To obviate this sort of thing, many supply authorities now make a practice of regularly changing the meter attached to any consumer's supply at intervals of, say, three years. Where trouble appears to be developing, the change is made whenever it appears necessary. A point in this connection, however, is worth noting. Unostentation may be overdone; it is not necessary to tell the world that an electric meter has gone wrong, but, on the other hand, it is due to the consumer to let him know that his meter is being changed. Some supply authorities omit to do this except in a casual way, and the result is confusion and strife.

The best way to go about the work if there are indications that the meter is recording inaccurately, is to send an inspector to examine it in the first instance. If his report shows trouble, it is worth while sending a postcard at least a day in advance, saying that the supply authority's men will be calling at a certain time to replace the old meter with a new one. This gives the householder an opportunity of taking the final reading on the old meter and the initial reading on the new one. A good many consumers nowadays prefer to keep a check on the authority's readings, and if a meter is removed without due notice, they are apt to complain. And their complaint is not altogether without justification.

German Electrical Industry Languishing.—The *Standard's* Berlin correspondent quotes a pessimistic view published in the *Tageblatt*, concerning the prospects of the electrical industry in Germany:—"It is pointed out that the German electrical industry is technically and scientifically ahead of that of other countries, but that there are insufficient orders to yield adequate returns for the vast capital invested in enterprises of this kind . . . Considerable disappointment is felt among those interested in the electrical industry that electrical railways have developed so slowly in this country . . . There is also a serious dearth of orders from foreign countries. 'The position of the electrical industry,' concludes this review, 'is not only sad, but there are no signs of any possible improvement in the near future.'"

Will.—It is reported in the Press that the late Mr. G. E. Belliss, of the firm of Belliss & Morcom, Ltd., of Birmingham, left estate valued for probate at £285,254 gross, the net personalty amounting to £276,723.

Fire.—At the Central Technical College, Exhibition Road, South Kensington, on Monday afternoon a fire occurred through a muffle gas furnace being left unattended in the chemical laboratory, and damage was done to apparatus and instruments.

(*Continued on page* 771.)

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The Electrical System of the L.C.C. Tramways.

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The H.T. switchgear at Greenwich is of the electrically operated, remote-control type, and is arranged on two galleries on the east side of the engine room. It was supplied by the British Westinghouse Co., and controls 8 generators and 32 feeder circuits in 8 sections.

The arrangement of the H.T. switchgear may be briefly described as follows :—

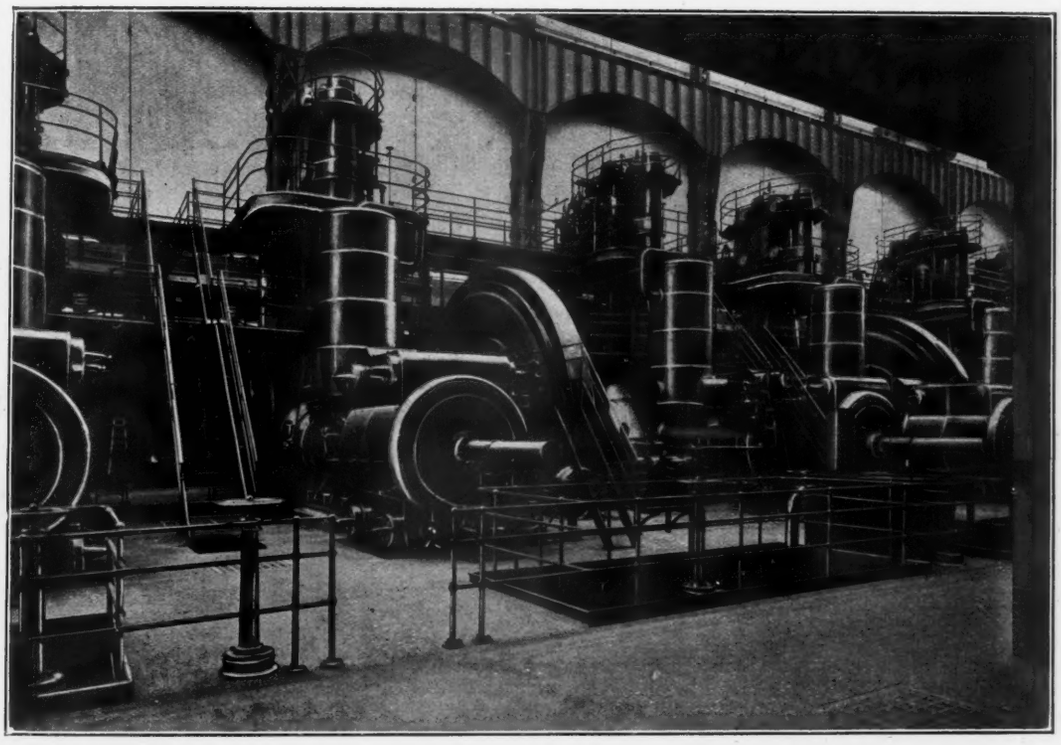
A three-core cable comes from each generator to a trifurcating box on the first gallery, where it is divided into three separate conductors, and, after passing through isolating plugs and series instrument transformers, is connected to the generator oil switch on the second gallery. Following on from the other side of the generator oil switch are isolating plugs, the connections to the main bus-bars, further isolating plugs, and then the section oil switch. Beyond the section oil switch are other isolating plugs, and then come the section bus-bars.

Lead-covered three-core cables are used, wherever possible, for connecting up between the various apparatus comprising the H.T. switchgear.

The isolating plugs are carried in spring jaws mounted upon insulators built directly into the wall, while the instrument transformers, consisting of three series and two shunt transformers for each feeder and generator, are contained in cast-iron tanks carried upon girder brackets built out from the wall. The oil switches are mounted in glazed brick sections.

The control switches and instruments for the eight generators are brought to the centre of the control desks, being arranged four on each side of the middle stanchion. The greater part, therefore, of the work of the switchboard attendant can be carried out without his having to move far from the central position.

In addition to the synchronising apparatus on the switch



3,500-KW. VERTICAL-HORIZONTAL ENGINE AND GENERATOR FROM UNDER THE SWITCH GALLERY.

Each set of section bus-bars controls four feeders through isolating plugs and feeder oil switches on the second gallery, and instrument transformers and isolating plugs on the first gallery. The feeder trifurcating boxes below the isolating plugs connect up to the lead-covered feeder cables. Spark-gaps are fitted to all the feeder circuits.

The generators are connected to the bus-bars by means of links in the form of isolating plugs, and, in the event of any accident to the main bus-bars or to the synchronising gear, any machine can be run independently on its own section of four feeders merely by withdrawing these plugs or link switches. The bus-bars are divided on the middle line of the station by a main interconnecting switch, by which the whole of the H.T. switchgear can be divided into two independent sections if necessary.

The lower gallery contains the control desks, the instrument boards, the generator and feeder isolating plugs, and the instrument transformers. The upper gallery contains the oil switches with their isolating plugs, the main bus-bars, and the spark-gaps arranged in blocks of four.

gallery, a synchronoscope is fixed near the stop valve of each engine and turbine for convenience in starting.

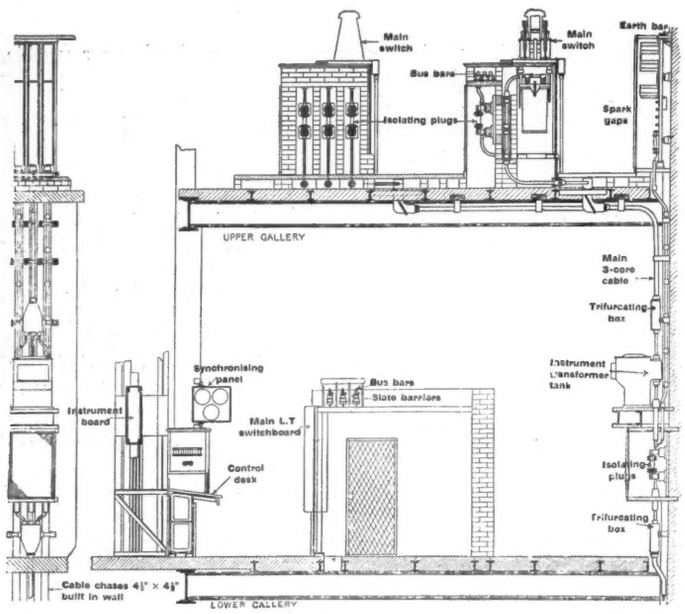
Reverse-current relays are fitted in the generator circuits and time-limit overload relays in the feeder circuits. Experience with the reverse relays has almost converted the author to the opinion that the generators should have no tripping relays of any kind whatever.

In addition to the high-tension switchgear, other switchgear is provided for controlling the auxiliary machines and the motor, lighting, and track-feeder panels.

It will be noticed that the spark gaps can discharge to a common earthing system, which consists of three 19/12 bare cables coupled to the condenser water pipes. Until recently the central points of the star windings of the generators were also coupled to this system, but owing to local currents being set up through these connections, having a periodicity three times the normal, and to other difficulties when the external system earthed, it was decided to place a resistance in the earth connection.

After considering the various difficulties connected with

this particular case, an ingenious automatic switch, designed by Mr. E. V. Shaw, was introduced, which ensures that only one machine, and that a running one, shall be connected to earth through a suitable resistance. The principle on which this switch is constructed was described by Mr. Shaw in an article which appeared in the REVIEW of October 18th, 1907.



SECTION THROUGH H.T. SWITCH AND CONTROL GALLERIES, GREENWICH POWER STATION.

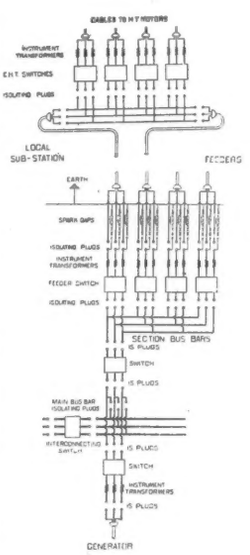


DIAGRAM SHOWING FEEDER CONNECTIONS, &C., TO ONE GENERATOR.

The earthing resistance is made up in eight different sections of cast-iron grids, arranged in 64 frames; the combined resistance is about 3·5 ohms.

The switches connecting the generators to earth are of the single-pole oil type, and are large enough to carry 500 amperes for 15 minutes and to break this current at 6,600 volts pressure.

The whole of the operation of the solenoids of the oil switches, automatic motor, pilot lamps, &c., of the earthing device, is carried out by direct current at 125 volts pressure, and the supply is taken from either the auxiliary machines or a set of accumulators.

The battery of accumulators consists of 280 Tudor cells of 645 ampere-hour capacity on a three-hour rating, coupled in series. The battery is worked in parallel with the bus-bars of the local sub-station, and is used as a stand-by for the supply, not only to the local track circuits, but also to the 550-volt direct-current power and arc-lighting circuits in the generating station. A tapping at the 125-volt point is taken off, and is connected in parallel with the auxiliary machines, so that there is a stand-by for the switchgear operation also.

The battery is maintained under contract for a period of ten years on payment of a total sum equal to about 67 per cent. of the original cost.

The cooling water for the condensers is obtained from the River Thames. Four 30-in. pipes are laid in the bed of the river to a distance of about 100 ft. in front of the coaling pier, and two additional 30-in. pipes are now being laid; the ends of the pipes are bell-mouthed, and are carried in a concrete basin.

The four suction pipes connect through valves to fixed strainer boxes, which are iron boxes containing a coarse mesh grid.

There are three electrically-driven centrifugal pumps, two of 24-in. bore, each capable of passing 12,000 gallons per min., and one of 27-in. bore, capable of passing 20,000 gallons per min. The pumps were made by Drysdale, of Glasgow, the two smaller ones being driven by E.C.C. three-phase slip-ring induction motors of 250 B.H.P., and the larger by a 350-B.H.P. Dick, Kerr motor.

Each pump connects directly on the suction side with one of the fixed strainer boxes, and on the delivery side to the inlet of a rotary strainer; beyond the rotary strainers the pipes pass into the engine room in three separate lines of 24-in. pipes, cross connected in the valve house in such a way that all three lines may be fed from any two pumps.

The return pipes from the engine room are cross-connected in a similar manner before being joined up to the rotary strainers, so that the return water passes through the latter in the opposite direction to the flow. The three discharge pipes then join up to an omnibus pipe, which is connected to the two 30-in. discharge pipes in the river.

The rotary strainers, which were constructed by Messrs. Bailey & Jackson, will deal with about 1,000,000 gallons of water each per hour.

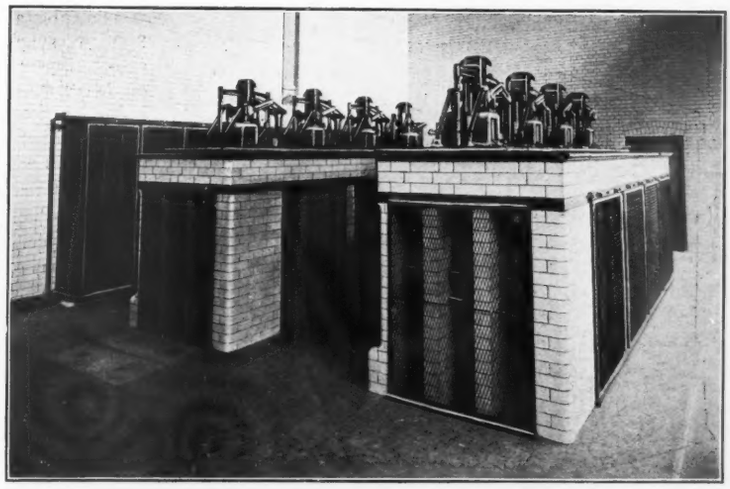
The circulating pipe system is completely sealed, full advantage of siphon action and consequent saving of power for pumping is obtained, and all fibrous refuse is automatically rejected and returned to the river. The only disadvantage is that about 15 per cent. of the water leaks past the rotary strainer partition, and is returned to the river without flowing through the condensers.

VIEW ALONG SWITCH GALLERY, SHOWING CONTROL BOARD ON THE LEFT AND L.T. BOARD ON RIGHT.

To relieve the condenser-pipe system of any air which might accumulate, two 6-in. barometric siphon pipes are arranged, which extend about 40 ft. vertically, and are connected at the bottom to the highest points of the pipe system. Two dry air pumps take the air from the top of the barometric pipes.

The sub-station on the south side of the switchgear recess is equipped with three 500-KW. induction motor-generators, and is used for supplying the local tramway tracks and the auxiliary 550-volt direct-current motors in the station. The arc lighting is also supplied from this source.

Hand-operated overhead cranes are fixed in the strainer, centrifugal pump, and valve houses, and a 10-ton electrically operated crane in the workshop and sub-station. The engine room has a 50-ton overhead travelling crane, worked by four three-phase motors.



FEEDER OIL SWITCHES ON THE UPPER GALLERY.

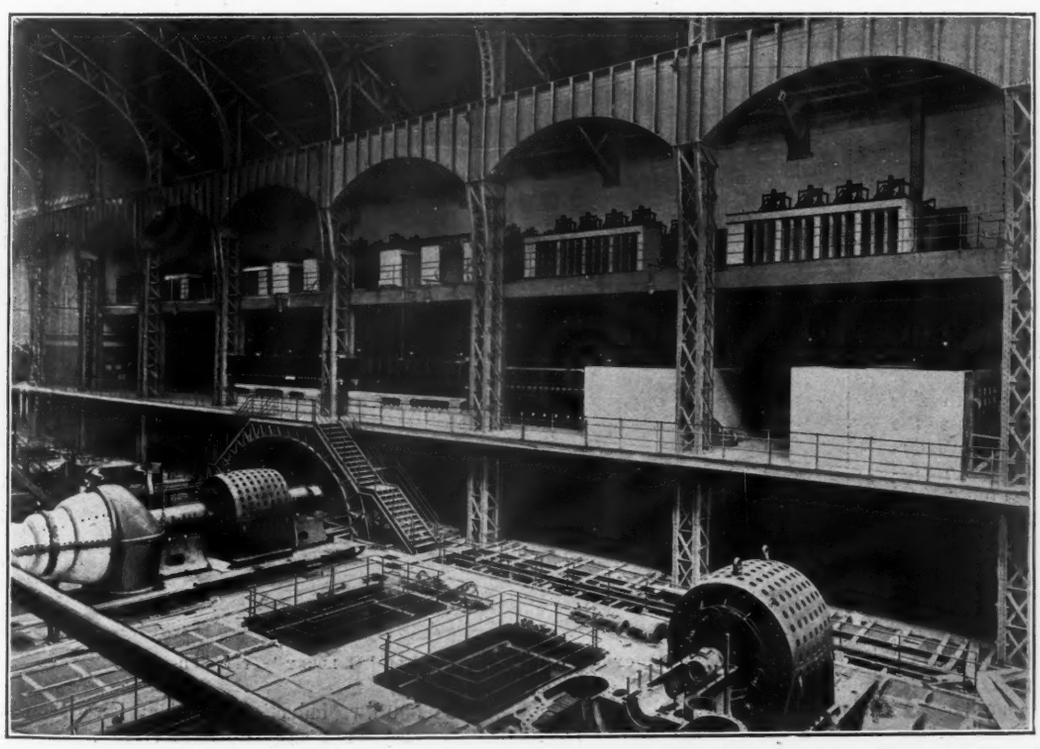
The station is lit by 79 arc lamps, arranged generally in series of five, and about 1,250 incandescent lamps. Although the equipment of the station is not quite completed, the total cost is known within very narrow limits, and is made up as shown below.

	Cost.	Per kilowatt.
Land and buildings	£334,000	£9·82
Pier and river work	60,180	1·77
Engines, turbines, alternators, and condensers	197,920	5·82
Boilers and economisers	102,460	3·01
Main and auxiliary switchgear, accumulators, station wiring, lighting, tools, &c.	35,600	1·05
Steam, exhaust, and condenser piping, pumps, strainers, and tanks	54,800	1·61
Coal and ash cranes and conveyors, locomotives, &c.	10,950	0·32
Cranes, turntables, railway track, &c. ...	7,560	0·22
Total	£803,470	£23·63

The following figures as to the operation of the station are for the year ended December 31st, 1908, and relate to the first half of the station only :—

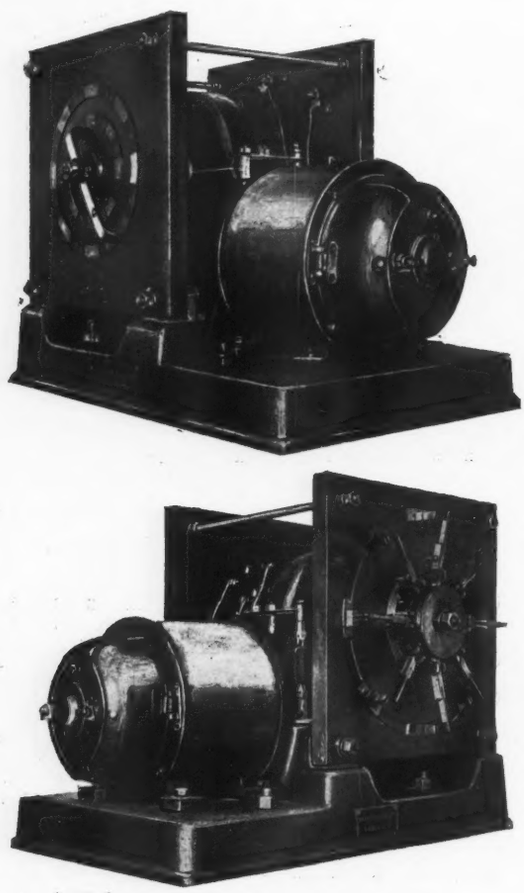
Units delivered to sub-stations	66,836,206*	
Maximum load in kilowatts	16,000*	
Station load factor	47·75 per cent.	
Coal	92,672·5 tons.	
(Partly at 14s. 5d. per ton, and partly at 11s. per ton.)		
Coal per unit delivered to sub-stations ...	3·1 lb.	
		Per unit.
Coal (including unloading) and removal of ashes	£64,797	0·2327d.
Salaries and wages, running staff	9,840	0·0353d.
Oil, waste, water and stores	2,164	0·0078d.
Repairs to plant and buildings (labour and materials)	5,014	0·0180d.
Management, insurance, and miscellaneous	1,697	0·0061d.
Rent, rates and taxes	8,696	0·0312d.
Total	£92,208	0·3311d.

* It is estimated that for the year ending March 31st, 1910, these figures will be respectively 91,000,000 units and 21,000 kilowatts.



GENERAL VIEW OF THE SWITCH GALLERIES AND NEW TURBINE PLANT, GREENWICH TRAMWAYS POWER STATION.

High-pressure three-phase energy is at present transmitted to 13 sub-stations on the south side of the river, and 10 sub-stations on the north side.



Views of Motor and Switch Panels, Automatic Earthing Switch.

A three-core paper-insulated lead-covered cable, with conductors 0·15 sq. in area, runs directly to each of the sub-stations; but certain sub-stations—*e.g.*, the Elephant and Castle, Shoreditch, and Holloway—have two such feeder cables. The sub-stations are also linked together by a similar cable with conductors 0·075 sq. in. area, forming an interconnecting main, so that each sub-station really has three sources of supply: (1) by the feeder directly from Greenwich, (2) and (3) from the nearest sub-station on either side.

On the south side of the Thames the sub-stations are interconnected in two independent groups, and on the north side in one group only at present.

The three-core high-tension cables, both feeders and interconnectors, are provided with a copper sheath immediately inside the lead. They are drawn into stoneware ducts which are laid in banks of from 3 to 32, the cables for the north side of the Thames being carried through the Blackwall Tunnel in the cable subway beneath the roadway.

The sub-stations which were first built were equipped with 300-kw. synchronous motor-generators, but all the other sub-stations with one exception have motor-generators, each of 500-kw. capacity. The majority of these are of the induction type. The actual numbers and sizes of the machines now fixed, on order, or in course of erection are as follows:—

17 motor-generators, 300-kw. capacity, synchronous type,
58 motor-generators, 500-kw. capacity, induction type,
6 motor-generators, 500-kw. capacity, synchronous type,
2 motor-generators, 1,500-kw. capacity, induction type,
2 rotary converters, 1,500 kw. capacity, synchronous type.

These machines have been made by Messrs. Dick, Kerr, the British Westinghouse Co., the Electric Construction Co., the General Electric Co., and Siemens Bros. The total capacity at present installed or on order is 43,100 kw., while in the sub-stations already built or projected there is space for further motor-generators of 16,400-kw. capacity, which makes a total possible plant capacity in the sub-stations of 59,500 kw. This is calculated to be more than sufficient for the total output of the Greenwich generating station, of which the approximate maximum top load is reckoned at 30,000 kw., as follows:—

Approximate maximum top load, Greenwich ...	30,000	kw.
Add for diversity factor of sub-stations = (1·25)	7,500	„
Approximate total demand of sub-stations ...	37,500	„
Add one-third for spare plant	12,500	„
Total plant required for sub-stations...	50,000	„

All the motors have the stators star-connected and wound to take the full-line pressure of 6,600 volts between phases. The central point is not connected to earth.

The magnets of the generators are all shunt wound, this has simplified the switchgear, and removed certain risks of reversals of polarity in the machines.

The 300-kw. and the 500-kw. motor-generators, both of the induction and synchronous type, run at the same speed, viz., 300 r.p.m., while the 1,500-kw. motor-generators run at 137 r.p.m., and the rotary convertors at 250 r.p.m.

Each of the 300-kw. synchronous machines has its rotor excited at 125 volts from a small direct-current generator mounted on the same shaft, while each of the 500-kw. synchronous machines has its rotor excited at 550 volts from its own generator.

If necessary, any 500-kw. machine can be taken from one sub-station to another, without having to make any alterations in the foundations.

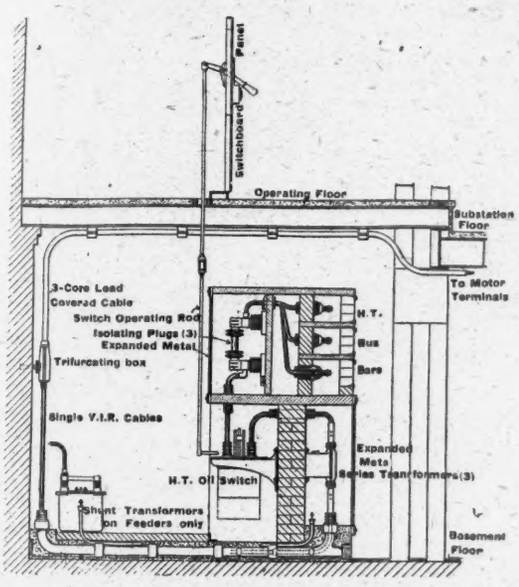
Interior of the L.C.C. Forest Hill "Gallery" Type Sub-station.

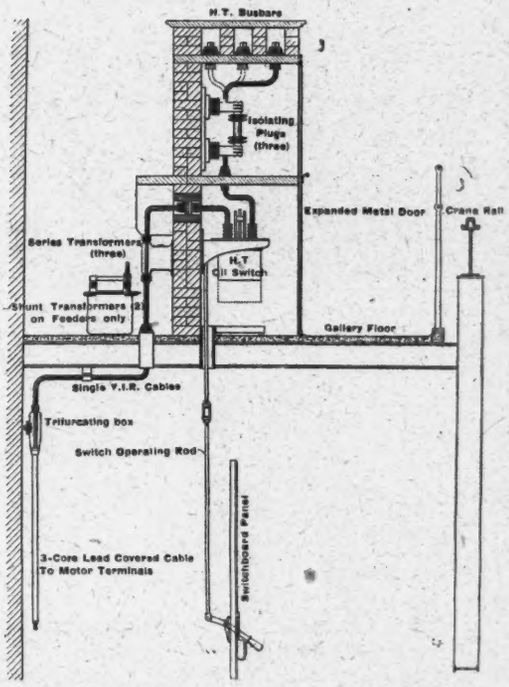
The 500-kw. induction machines have short-circuited rotors; they are started up from the direct-current side. To indicate synchronous speed a small enamelled iron disk,

painted with alternate black and white sectors, is screwed to the end of the shaft; when illuminated by a 25-cycle incandescent lamp, these sectors appear stationary if the machine is at synchronous speed; this method takes into account any variations in the speed of the main generators at Greenwich.

The synchronous motor-generators are also brought up to speed from the direct-current side, and synchronising apparatus of the ordinary type is used for switching them into parallel with the bus-bars.

To start either of these machines in a sub-station which is entirely shut down, a small self-starting induction motor-generator of from 50-KW. to 150-KW. capacity is used, which is fed on the alternating-current side from a three-phase





SECTIONS THROUGH H.T. SWITCHGEAR, TYPICAL "BASEMENT" AND "GALLERY" SUB-STATIONS.

transformer at 220 volts. This transformer is also used for the lighting of the sub-station, and, although the frequency is only 25 ~ per second, the incandescent lighting is perfectly steady to the eye.

The 1,500-KW. motor-generators at the Elephant and Castle sub-station have wound rotors with slip rings. A water resistance is inserted across the rings at starting, and the full bus-bar pressure is switched directly on to the stator. The machine then gradually gathers speed, and the resistance is cut out by degrees, until, when the machine has reached full speed, the slip rings are short-circuited.

Considerable trouble was originally experienced, owing to the breakdown of stator coils on the 500-KW. induction motor-generators at the time of switching on to the bus-bars.

This led to careful investigation with the oscillograph, which, however, showed no abnormal rise of pressure at the moment of switching in a machine.

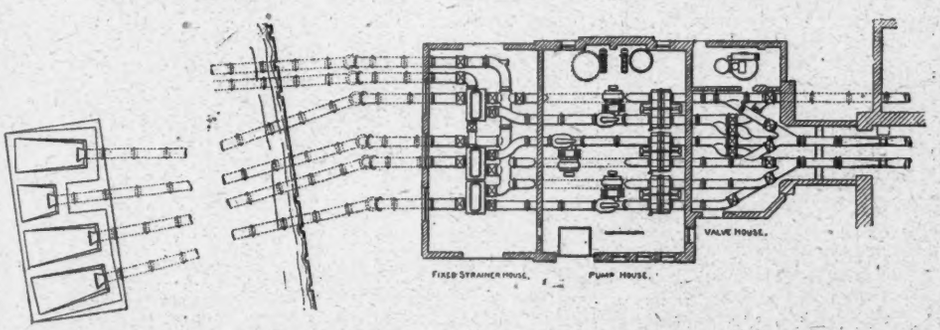
Extra insulation between turns of terminal coils reduced the trouble, but did not cure it; and eventually it was decided that the form of the coil had a good deal to do with the trouble, and consequently a standard specification is now enforced for all motor-generators, whereby the stator windings consist of one coil of only one turn wide per layer per slot, made into partially formed coils before inserting in the slots. If necessary, the external loops are also secured mechanically.

It was also decided to switch in the machines through choking coils, which were afterwards short-circuited. The coils are proportioned to absorb about one-half the voltage across the bus-bars.

A number of such coils and short-circuiting switches have been fitted, and appear to have had very beneficial results.

A 10-ton hand-operated overhead crane is provided in each sub-station, while, at the Elephant and Castle sub-station, where there are motor-generators of 1,500-KW. capacity, there is a 25-ton, three-motor crane.

The sub-station switchgear is, as far as possible, uniform in type and arrangement. The operating gear is mounted on a platform; and the L.T. machine and feeder switches are mounted on the fronts of the panels, while the H.T. switches and transformers are erected in brick cells, either in a basement below the switch platform or on a gallery above, and the operating gear only is mounted on the panels.



PLAN SHOWING ARRANGEMENT OF RIVER PIPEWORK, PUMPS, FIXED AND ROTARY STRAINERS, &C.

Cross-sections of the H.T. switchgear of a typical "basement" sub-station, and of a typical "gallery" sub-station are shown. The differences in the arrangement of the gear in the two types will be evident. The gallery type is a cheaper sub-station to build, and the switchgear is more accessible and better lighted.

Every endeavour has been made to obtain machines and switchgear of the simplest possible kind. For this reason induction motors and shunt-wound generators have been largely used, and all instruments and apparatus which were not absolutely necessary have been gradually eliminated.

A description of the L.T. track-feeder switchgear is somewhat bound up with the special arrangements rendered

necessary for feeding the conduit system. Two separate conductor bars are used in each conduit, one being positive and the other negative; the track rails are not used at all. The conductor bars are divided into sections of approximately ½ mile in length, and each ½ mile section is separately fed from a sub-station.

The conduit system is subject to many faults from which the overhead system is free. These faults are sometimes on the cars (generally in the plough), but more frequently are found in the conduit itself, due to foreign conducting substances falling through the slot rails. As both positive and negative conductor bars are used, positive and negative earths may occur simultaneously on two different sections fed from the same sub-station; in such a case the positive fault can be changed at once into a negative fault by reversing the polarity of the track feeders of the section having the positive earth.

Electrical car and track faults resolve themselves into four kinds—viz., (1) negative earth, (2) positive earth, (3) short-circuit between positive and negative without earth, or (4) short-circuit with earth. These various faults are detected and dealt with very readily by the type of switchgear adopted.

The track-feeder panels are each fitted with a double-pole change-over switch, having auxiliary contacts on each pole at the top and bottom positions. These contacts are insulated from the main contacts, and when the blades of the switch are pulled out of the main contacts into the auxiliary contacts, either at the top or the bottom, the track feeders are coupled to the bus-bars through a fixed metallic resistance of 5 ohms, in connection with a special testing panel set at right angles to the main switchgear.

The negative bus-bar of the sub-station is connected to earth by means of an adjustable water resistance, which can be varied between infinity and a dead earth. It is usually kept at about 1 ohm. All track positive faults, therefore, show themselves at first as short-circuits and open the circuit-breaker of the track feeder connected to that section. The attendant at once pulls the change-over switch, which is, say, in the top position, into the top auxiliary contacts, and, by means of the handle and connecting rod across the front of the panels, closes the circuit-breakers on the testing panel. The indications of the two ampere meters on that panel will then show whether the fault is only a temporary one or whether it is permanent, and, if the latter, whether it is a bad earth fault or not.

As was mentioned earlier, many of the faults occur on the cars themselves. To locate quickly a car which has a negative fault, a trap is set by permanently reversing the polarity of the track which is nearest to the sub-station. When the faulty car enters that section its fault is reversed to the positive side, the breaker opens, and the attendant is usually able to stop the car on the road and have it sent to the shed at the first opportunity.

The track leakage of each half-mile section is measured every night at a convenient time between midnight and 3 a.m. The polarity of the section is reversed for about half an hour previously to dry off any dampness on the negative conductor insulators. The leakage between conductor bars generally varies between 0 and 2 amperes per half-mile of double track, depending upon the state of the weather.

The various high and low-tension feeder and machine circuits are protected by automatic cut-outs, worked directly in the case of the direct-current circuits, and by transformers through relays in the case of the high-tension circuits. The circuit-breakers on the L.T. track panels are of the plain overload type without time limit. Considerable difficulty was originally experienced in obtaining breakers which would stand the very severe work which these are called upon to do, in consequence of the liability of the system to dead short-circuits across the conductor bars.

The breakers next in the series are those on the direct-current panels of the motor-generators. These are of the reverse-current type, and, by the use of a separate starting panel, are cut out of the circuit when their motor-generator is being started up.

The H.T. side of each induction motor-generator is protected by a time-limit overload relay, and of each synchronous motor-generator by a reverse-current relay in each phase. The H.T. feeders are protected in the sub-stations by a reverse-current relay in each phase, while at Greenwich they are protected by overload time-limit relays, as was mentioned earlier. As the H.T. interconnecting cables between the various sub-stations are used to transmit energy in either direction, time-limit overload relays had to be used at each end instead of reverse-current relays. The usual settings for the time-limit relays are as follows:—

L.T. track circuits	No time limit.
H.T. side of induction motor-generators ...	3–5 seconds.
H.T. interconnectors	6–7½ seconds.
H.T. feeders, Greenwich	10 seconds.

The efficiency of the various motor-generators at full load is about 90 per cent., but as the tramway load is a very fluctuating one the all-day efficiency of a sub-station as a converter of electrical energy does not usually exceed 75 per cent. The diversity of the sub-stations—*i.e.*, the ratio of the sum of the maximum loads on the individual sub-stations to the maximum load on the generating station—in any one day is about 1·25.

The cost of the Shoreditch sub-station (3,000 KW.) was as follows:—

		Per kilowatt.
Motor-generators	£10,400	£3·47
High and low-tension switchgear ...	3,420	1·14
Crane, tools, lighting, &c.	400	0·13
Land	10,000	3·33
Buildings, offices, stores, &c. ...	6,520	2·17
Total	£30,720	£10·24

The low-pressure cables are lead-covered paper-insulated single-core conductors drawn into stoneware ducts; they terminate in feeder pillars, which are fixed at ½-mile intervals on the tramway routes. At important junctions several feeder pillars are used.

The pillars are of special design as they have to deal not only with two feeders from the sub-station, but with four sets of positive and negative cables going to the tracks.

Each feeder pillar is provided with a hand telephone apparatus, the lifting of which from its rest rings the telephone bell in the sub-station which feeds that particular pillar.

Vulcanised bitumen cables are used entirely for all connections to the conductor bars in the conduits, whether from the feeder pillars or between sections of the track. As breaks have to be left in the bars at all junctions and crossings, so as to give the ploughs a free passage in either direction, the "jumper" cables form quite an important part of the underground mains system, and owing to their position they are very liable to faults.

The Apathy of British Manufacturers.—During the discussion on Mr. Andrews's paper on "Gas Engines" at the Institution of Electrical Engineers, at least one representative of British gas engine makers complained that the paper contained so little about engines made in Great Britain. To this complaint Mr. Andrews replied that he had asked for information to put into the paper, and it had not been forthcoming beyond a photograph or two. This apathy is only too common. The writer of this note asked for some information from a firm of engine makers, who replied that they were too busy to attend to such inquiries. No one will find fault with such an attitude if it is consistently maintained, but it is not consistent to refuse information and then to complain of those who do furnish it. Everyone is well aware that foreign gas engine makers have been very busy selling engines in this country, and that they have done so by the publicity they have given to the fact that they have such engines to sell. Some engineers have a regularly organised publicity department, whose duty it is to attend to all such inquiries as have to do with Press articles. Firms who have no such publicity department positively do not know what is necessary to fill a request for information. They do not know, for example, that a silver-print photograph is best from which to make a process block; that a process block does not make a good reproduction owing to the grating effect. They do not know that a line drawing should be black on white, and that purple-black sun prints are not useful. Nor do they realise the importance of thick line drawings when intended to be reproduced on a smaller scale. A publicity department can soon pick up this knowledge from inquiries if it will do so, but where casual publicity is handed over to one draughtsman or another, or to any chance clerk, it rarely happens that satisfactory information is given out. The condition of affairs shown by the complaint referred to, and by Mr. Andrews's reply, is far from uncommon, and evinces a state of apathy which cannot be considered good business.

NOTES.

(*Continued from page 764.*)

What's the matter with Canadians?—Under this heading—a title which at once excites our curiosity—the *Canadian Electrical News* writes as follows:—"Why is it in Canada that no Canadians need apply? Perhaps you do not think that this state of affairs exists, but if you will take the trouble to investigate a little, you will without doubt come to the conclusion that conditions in this respect are in anything but a satisfactory state. When it is recalled that the erection of the Quebec bridge was very largely in the hands of engineers foreign to this country, a good reason is obtained for saying that foreigners have had their turn, and that it is now time to try the home product. In addition to this injustice on the part of the Dominion authorities, the Ontario Government have more or less to answer for in connection with the Hydro-Electric operations. The City of Toronto and the City of Hamilton have both thought it necessary to go outside the country for technical advice, and, if newspaper reports be true, two of our largest operating companies have been unable to find in all of our broad dominion the men to fill very fair positions which were lately vacant on their staffs. Surely these things should not be, and for a number of excellent reasons. To begin with, practically all the appointments, if not absolutely all, are connected with bodies or undertakings which make their incomes from Canadians and Canadian enterprise and industry. It is but a small return, and one most justly due, that Canadians should form their various staffs. Then, again, as with the body physical so with the body national, a faculty neglected will surely become a faculty entirely lost, and our younger men, seeing nothing ahead of them but the creation of good things for foreign competition, will gradually drift off to other countries, or at least to other pursuits; a distinct loss, not only to the engineering profession in Canada, but to the country at large. Lastly, are those who go outside their own country for their trained men getting better value for their money than they can get at home, which would, of course, explain why they do it? We know they are not, for examples to the contrary are notorious. Why then does such a state of affairs continue?" On another page our contemporary reports:—"An amendment to the Stationary Engineers' Act has been introduced in Parliament, stating that no one shall be eligible to take the examination for a stationary engineer, unless he is a British subject and has resided in Canada for at least three years. The Canadian Manufacturers' Association fear that this might cause serious trouble in times of labour difficulties, and it is possible that the Association will bring its influence to bear in opposition to the Bill."

Refuse Destruction.—In a paper read before the Incorporated Association of Municipal and Country Engineers last month, Mr. W. F. Loveday dealt with the design and working of a modern destructor, and gave particulars of a test carried out at the St. Albans electricity works of the North Metropolitan Electric Power Supply Co. in January last, under the supervision of Mr. E. T. Ruthven Murray, engineer-in-chief. The test lasted 8¼ hours, and 26,166 lb. of refuse was consumed, on a grate area of 43 sq. ft. The boiler was of the water-tube type, having a heating surface of 1,966 sq. ft. The equivalent evaporation per lb. of refuse from and at 212° F. was 2·75 lb.; the temperature in the combustion chamber ranged from 1,904 to 2,318° F., and the average percentage of CO_2 in the flue gases was 12·2. The electrical output was 1,180 units actually generated, but on the basis of 30 lb. steam per unit it would have been 1,836 units; on the latter basis also the gross output per ton of refuse was 159 units, and the net output after providing for forced draught and feed pump, 153 units, available for power supply. The cost of charging and clinkering was 7¾d. per ton. We are indebted to *The Surveyor* for these particulars.

American Promoters Disgorge.—The New York *Electrical World* says that Thomas F. Ryan, P. A. B. Widener, Thomas Dolan, and the estates of William C. Whitney and William L. Elkins have paid back to the Metropolitan Securities Co. the sum of $692,292. This is the amount which the promoters of the Metropolitan system paid to Anthony N. Brady "for distribution" at the time of the purchase of the Wall and Cortlandt Street Ferries Railway Co. Of this amount $245,681 was repaid by the Whitney estate, which was the amount Mr. Whitney originally received. The suit brought by the Metropolitan Securities Co. has been discontinued. The fact that this large amount had been paid to the promoters was brought to light through an investigation of the Public Service Commission.

"In Consequence of Electrification."—The benefit that electric traction confers on tunnel railways is emphasised once more in an interesting advertisement just published by the Mersey Railway, in which the directors invite tenders for the sale of ventilating fans, engines, boilers, pumps, water column, turntables, &c., "for which they have no further use in consequence of the electrification of the railway."

The Late Mr. Yerkes's Estate and his London Underground Shares.—There is occupying attention in the Courts at New York a claim by the London Underground Railway Co. against the estate of the late C. T. Yerkes. The *Electrical Review and Western Electrician* says that the claim amounts to $800,000, and represents what Mr. Yerkes owed on his stock holdings in the company at the time of his death.

Inquiries.—Makers of Regin Core Solder are asked for.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Coventry City Council at their meeting on Tuesday adopted a recommendation from the E.L. Committee that MR. G. TOUGH be appointed to the post of electrical engineer and manager at a salary of £360 per annum, the duties to include the carrying out of any architectural work required. The adoption of this recommendation also carried with it the authorisation of the engineer to appoint a station superintendent, which post is now being advertised. Alderman West, chairman of the Electric Light Committee, in moving the adoption of the recommendation, stated that Mr. Tough had been in the employ of the Corporation for nearly ten years as station superintendent and had been in charge of the station during the past six months since the resignation of their late engineer, and he had shown himself quite capable of carrying out the duties equally well electrically, mechanically and commercially.

The Fulham B.C. last week resolved, by 26 votes to 8, to increase the salary of MR. A. J. FULLER, the electrical engineer, from £500 to £525.

The Electricity Committee of Aston Manor T.C. has recommended that the salary of MR. ROBERT FOSTER, electrical engineer, be increased from £400 to £500 per annum, as from April 1st last.

On April 8th at St. George's, Campden Hill, W. Miss Jennie Stone was married to MR. MANLEY FARRER, resident engineer to the Twickenham and Teddington Electric Supply Co., Ltd.

MR. FREDK. H. EDWARDS, station engineer for both the Woolwich Borough electricity works, has been appointed by the Erith District Council as chief assistant electrical engineer. We are informed that MR. H. H. CLARE, senior charge engineer at Woolwich, will probably be appointed station engineer for Woolwich.

The staff of the Aberdeen Corporation Electricity Department met on 29th ult. to do honour to MR. RICHARD B. W. PIRIE, their erstwhile colleague, who, as we have already announced, has secured the position of chief internal auditor to the British Columbia Electric Railway Co., Ltd., in Vancouver City. Mr. Bell, electrical engineer of the department, presided over a company of 18, and after dinner a varied and interesting programme of song and instrumental music was enjoyed. Mr. Pirie sails from Liverpool to-day (Friday).

Tramway Officials.—Following on the resolution of the last Council meeting appointing MR. HILL, of Birmingham, to be general manager of the Bournemouth Corporation Tramways, MR. CECIL BARBER, A.M.I.C.E., M.I.E.E., has resigned the position of works engineer and traffic manager, which position he has held for the past seven years, since the commencement of the Bournemouth system.

General.—The retirement of MR. J. W. WILLMOT from position of Controller of the Post Office Telegraph Factories took place on the 1st inst., and marks the close of a successful career extending over a period of 49 years. He entered the service of the Electric and International Telegraph Co. in 1862, and it was not long before his general ability was recognised, and he became attached to the Engineer-in-Chief's Department as one of the technical officers; he was transferred to the Post Office on the acquisition of the telegraph companies by the State in 1870. Here he was entrusted with the important duty of installing a pneumatic tube system at the General Post Office, from which radiated lead tubes placed in iron pipes to various points in the City, and eventually to the House of Commons. He subsequently installed similar systems, but not, of course, of such magnitude, in the principal commercial cities of the provinces. He designed a single and double sluice valve for use in the pneumatic system, by which carriers conveying the messages were rapidly inserted and removed from the tubes and the necessary vacuum or pressure turned on. Another of his inventions was an intermediate signaller, by which the carrier, having passed a certain point, actuated the apparatus which signalled to the sending station that the certain distance had been covered, and that, therefore, it was safe to insert a second carrier; this resulted in a considerable increase in the working capacity of the tube. This special work did not exclude him from participating in the development of the telegraph system nor in the introduction of telephones into this country. In 1880 Mr. A. Stroh, who had been supplying the Post Office with automatic and A.B.C. instruments invented by Sir Charles Wheatstone, signified his intention of retiring from business, and in order that a body of skilled workmen experienced in such work should not be dispersed, his workshops were taken over by the Government, and Mr. Willmot was selected to make the necessary arrangements and to be superintendent of these shops. He continued to hold the position of superintendent of the instrument factory until a rearrangement brought about the creation of the position of Controller of Factories, to which he was appointed in 1902. On the telegraph side Mr. Willmot invented a magnetic bias for the high-speed Wheatstone transmitter, a hollow punch for perforators, and a pneumatic motor for the Hughes instrument, besides which numerous instruments have been improved in certain details by his practical knowledge and originality. Mr. Willmot's abilities as an engineer were recognised some years ago by his election as a member of the Institution of Civil Engineers. The appreciation of his services to the State was marked by the conferring upon him of the Imperial Service Order. In retiring from

the public service Mr. Willmot takes with him the best wishes of a number of friends in the Post Office, who will miss his general courtesy of manner and his ready assistance, whether it took the form of placing his long experience at their disposal or of contributing towards the relief of distress.

Messrs. Ados, Ltd., announce that Mr. S. E. Smith has ceased to act as secretary of that company, and all orders must be signed by the managing director, Mr. A. Willis.

Mr. E. Norman C. Rogers, A.M.I Mech.E., is a passenger from Southern Nigeria per ss. *Dakar*, and is due to arrive in Plymouth on May 5th.

Mr. R. D. Spanton, electrical engineer at Devonport Dockyard, was married on April 24th to Miss L. P. Bowley, of Devonport. Amongst the presents was a marble timepiece from the generating and sub-station staff.

The Stroud staff of the National Telephone Co. has presented an oak overmantel to Mr. Wm. Hodgetts, who has been appointed chief engineer at Swansea.

Messrs. Crews & Handford, consulting electrical engineers, are removing on May 10th to Clarence Chambers, 4, Piccadilly, Manchester.

In the *London Gazette* of April 30th the following announcement appears:—"Territorial Forces, Royal Field Artillery. 1st Monmouthshire Battery, 4th Welsh Brigade—Capt. Reginald J. Wallis-Jones to be Major." We offer our congratulations. Major Wallis-Jones is a keen enthusiast in military matters; he became an officer in the Volunteer Artillery in 1896, and prosecuted his studies with such effect that in 1900 he obtained the certificate of proficiency of the School of Instruction, Aldershot. Since then he has frequently been called upon to perform important functions in connection with the artillery branch of the service, and in 1905 he was elected a member of Council of the National Artillery Association.

CITY NOTES.

Eastern Telegraph Co., Ltd.—For the half-year ended December, 1908, the revenue amounted to £566,101; £202,365 is deducted for the ordinary expenses, and £51,278 for expenditure relating to maintenance of cables, sundry differences in exchange, and income-tax payable abroad, leaving a balance of £312,458, plus £53,765 brought forward, making a total available balance of £366,223. After providing for income-tax payable in England, interest on mortgage debenture stock, and dividends on the preference stock, which in all absorb £81,789, there remains a balance of £284,435, out of which the directors have placed £70,000 to the general reserve fund, and have paid an interim dividend of 1¼ per cent. on the ordinary stock, amounting to £50,000. The directors now recommend the declaration of a final dividend on the ordinary stock of 1¼ per cent., and a bonus of 2 per cent., amounting together to £130,000, both payable on May 12th, free of income-tax, and making, with the three previous payments on account, a total distribution of 7 per cent. for the year ended December 31st, 1908. It is proposed to carry forward the balance of £34,435.

Stock Exchange Notice.—The Committee has ordered the following to be quoted in the Official List:—

Great Northern, Piccadilly and Brompton Railway Co.—35,704 4 per cent. guaranteed preference shares of £10 each, fully paid, Nos. 1 to 35,704, in lieu of the shares now quoted.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—The report for the half-year ended December, 1908, states that the gross receipts amounted to £306,889, against £304,416 for the corresponding half-year of 1907. The working expenses, including £25,203 for maintenance of cables, absorb £151,507, against £154,203, leaving £155,382. From this is deducted £3,105 for income-tax payable in England, and £15,048 for interest on debenture stock, leaving as the net profit for the half-year £137,228. After adding £65,777 brought forward there is an available balance of £203,005. One quarterly interim dividend of 1¼ per cent. has been paid for the half-year, and it is now proposed to distribute another of like amount, making, with the interim dividends paid for the first half-year, a total dividend of 5 per cent. It is also proposed to pay a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year 1908. £50,000 has been transferred to the general reserve, and £18,005 is carried forward.

South Staffordshire Tramways (Lessee) Co., Ltd.—The profit for the year 1908 was £39; £467 was brought forward. Both amounts are carried forward; £4,577 was spent in respect of the reconstruction of the tramways in Tipton, Darlaston and Wednesbury. Sir Ernest Spencer has resigned his seat on the ard, and Mr. W. G. Bond has been elected in his stead.

West Coast of America Telegraph Co.—The ors' report for 1908 states that the gross receipts were £52,612, against £61,854. Out of £13,442 available, £8,000 has been placed to the general reserve fund and £2,000 to the maintenance ship's reserve fund, and the directors recommend a dividend of 2½ per cent., free of income-tax, carrying forward £629.

West India and Panama Telegraph Co.—The directors recommend the following dividends:—6s. per share on the first pref. shares (dividend for six months to December 31st) and 18s. per share on the second pref. shares (on account of dividends accrued to December 31st).

France.—La Société Nouvelle de l'Accumulateur Fulmen, of Clichy, Paris, is reducing its capital from £22,000 to £11,000.

Submarine Cables' Trust.—For the year to April 15th, 1909, the revenue amounted to £25,433, and the expenses to £1,167, leaving a balance of £24,266, plus £49 brought forward. After providing £18,105 to meet payment of the coupons, £5,982 has been transferred to the redemption fund, leaving £228 to be carried forward.

Western Telegraph Co., Ltd.—The directors' report for the half-year ended December 31st, 1908, shows that the revenue amounted to £343,668, and the working expenses to £133,673. After providing £16,000 for debenture stock interest, and £5,661 for income-tax, there remains a balance of £188,334; to this is added the sum of £4,260 brought forward, making a total of £192,594. First and second interim dividends, amounting to £62,379, have been paid, and after transferring £100,000 to the general reserve fund, £5,000 to the maintenance ships' reserve fund, £10,000 to the Marine Insurance fund, and £10,000 to the land and buildings depreciation fund, there remains £5,215 which is carried forward.

Wemyss and District Tramways, Ltd.—The balance-sheet submitted at the third annual general meeting at Leven stated that the income for the year was £14,206, and the balance at the credit of profit and loss account for the year was £3,177, after paying interest on the mortgage debenture stock and making provision for depreciation. From the profit and amount carried forward from last year, the 6 per cent. dividend on the preference shares has been paid (three half-years' dividends during the financial year) and a sum of £200 handed over to the trustees for the mortgage debenture stockholders in terms of the deed of declaration of trust, leaving the sum of £904, out of which the directors recommended a dividend of 6 per cent., less income-tax, on the ordinary shares, the balance of £334 being carried forward.

City of Buenos Ayres Tramways Co. (1904), Ltd.—A dividend of 1s. 3d. per share, less income-tax, for the three months ended March 31st, is announced.

West African Telegraph Co., Ltd.—The report for 1908 shows revenue amounting to £56,316; deducting £16,682 for the ordinary expenses, and £8,147 for expenditure relating to maintenance of cables, there remains £31,487, plus £831 brought forward. £1,343 has been provided for income-tax, £20,000 has been transferred to general reserve fund. The directors recommend a final dividend of 2 per cent., free of income-tax, making, with the interim distribution, 4 per cent. for the year, £1,731 being carried forward.

River Plate Electricity Co., Ltd.—The board has been offering an issue of 25,000 new 6 per cent. preference shares of £1 each to the holders of the existing preference shares in the proportion of one new share for every four shares held.

Lewes and District Electric Supply Co., Ltd.—The report for 1908 states that the capital expenditure during the year amounted to £3,671, making the total £30,206. The gross revenue amounted to £2,294, an increase of £202. Expenditure, including £307 for interest on temporary loans and £150 for new battery plates, was £2,065, leaving a profit of £229 *plus* £54 brought forward. The directors recommend that there be placed to depreciation and renewals account £250, carring forward £33.

Cascade (1906) Power Co., Ltd.—The report from October 1st, 1907, to December 31st, 1908, states that at the latter date there was £1,494 at credit of profit and loss account, and this is to be carried forward. £1,873 debenture stock had been redeemed. Since the date of the last report endeavours have been made to close up the sale of the undertaking of the Cascade Water Power and Light Co., Ltd., but owing to numerous delays the bonds to be issued under the arrangement could not be obtained or the accounts finally adjusted with the purchasers. The directors hope that the bonds may be received in the near future, and that they may shortly be in a position to report the completion of the arrangement and to submit proposals regarding the future of the company.

Primitiva Gas and Electric Lighting Co. of Buenos Ayres, Ltd.—The report states that the balance of revenue account for 1908, and the interest received from the German Trans-Atlantic Electricity Co., amount to £120,189. With the balance brought forward, there is a total of £136,128. Interest paid on debentures absorbs £22,522, and, after paying preference dividend and putting £10,000 to general reserve, the directors recommend a final dividend of 4s. 6d. per share (free of income-tax), making a total distribution of 7 per cent. for the year on the ordinary shares, and leaving £26,903 to be carried forward.

Clyde Valley Electrical Power Co.—For the past half-year the working has resulted in a credit balance of £1,030, which is carried forward. The demand for power has increased, contracts having advanced by 4,351 H.P. to 24,381 H.P.

Richardsons, Westgarth & Co., Ltd.—The directors (according to a financial daily) state that no payment in respect of the dividend on the preference shares is being made.

Calcutta Electric Supply Corporation, Ltd.—The directors recommend a final dividend for the second half of 1908 at the rate of 9½ per cent. per annum (making 8 per cent. for the year) on the ordinary shares. The dividend will be payable immediately after the general meeting on May 27th next.

Auckland Electric Tramways Co., Ltd.

The directors' report for 1908 states that the total revenue amounted to £165,655. The traffic receipts, which amounted to £163,848, show a satisfactory increase of £26,130. After deducting all expenses chargeable to revenue, including £15,718 for debenture and other interest, the rental and percentage of profits payable to the Auckland City Council, amounting to £3,772, and setting aside £12,500, compared with £10,000 last year, to the depreciation account, there is a surplus of £32,755, making, with £2,165 brought forward a total of £34,920, which the directors recommend should be appropriated as follows:—To reserve account £10,000, dividend on preference shares £3,000, dividend on the ordinary shares at the rate of 6 per cent. per annum £18,000, carried forward £3,920.

The authorised share capital is now £400,000, having been increased by £50,000 in ordinary shares in pursuance of a special resolution confirmed at an extraordinary general meeting of November 9th. Since the close of the year the new shares were offered to the existing ordinary shareholders, and the whole of them have been taken up. The capital expenditure during the year amounted to £52,611, which was principally for new cars, power station plant, and for the completion of the two extensions of the line in the Mount Eden district. During the year £50,000 first mortgage debenture stock, being the balance of the then borrowing powers of the company, was issued, making the total amount of the stock at the end of the year £332,387. Under the terms of the debenture stock trust deed the sum of £2,851 was last year applied in the purchase and cancellation of £2,713 of the issued stock. The two extensions in the Mount Eden district were open for public traffic during the past year. The route mileage of lines now operated by the company is 22·3 miles. Sixteen cars have been added to the rolling stock during the year to provide for the increasing traffic requirements of the lines, and five further cars are in course of construction. The company has been approached to construct some further extensions of the existing system, and the proposals put forward are receiving careful consideration. At the latter end of the year the chairman visited Auckland. The opportunity of personal discussion with the management and the local directors concerning the company's interests has been of undoubted advantage. The registered offices have been changed to the Electrical Federation Offices, Kingsway, W.C. Mr. R. P. Simpson has resigned his seat on the board, and Mr. W. G. Bond has been elected to fill the vacancy.

	1907.	1908.
Miles open—Route miles	19·2	22·3
Single line	6·99	8·15
Double line	12·21	14·15
Passengers carried	22,474,567	25,144,390
Average receipts per passenger	1·47d.	1·50d.
Average expenditure per passenger	0·83d.	0·92d.
Proportion of expenses to receipts	60 %	61 %
Number of cars working	71	87

The meeting was held on Tuesday at the Electrical Federation Offices, Kingsway. Mr. C. G. Tegetmeier, in proposing the adoption of the above report, said that the depreciation account now stood at £34,314. That account had been created for the purpose of providing for extraordinary expenditure on renewals and reconstructions, which in different years might fluctuate widely according to the necessities of the position. The expenditure had to be provided out of revenue, and their object was to equalise as far as possible the yearly charge upon the profit and loss account for the varying expenditure in different years on the renewals and reconstructions of their permanent way, plant, and equipment. The expenditure on those items last year, apart from the ordinary expenditure on repairs and maintenance, amounted to £10,594, which had been charged to the account. On the other hand, they had added to the account out of last year's profit £12,500—£2,500 more than in the previous year. They had drawn somewhat heavily upon the depreciation account during the last two years. A good deal of the expenditure was of an exceptional character, but with the increasing life of the undertaking they were getting nearer to the time when extensive renewals, more particularly in the permanent way, would become necessary. The directors considered it prudent, therefore, to make increased provision this year and maintain the account at an adequate figure. In regard to the capital expenditure, this showed an increase during the year of £52,611. A large portion of that expenditure was in connection with the completion of the extensions in the Mount Eden district, which were opened for traffic during the year. The rest of the expenditure was principally for additions to the power station plant and for new cars. During the present year they had further considerable capital expenditure in view. When their undertaking was initiated, it was not anticipated that their generating and distributing arrangements would be called upon to meet demands that had since developed. From time to time they had made large additions to their power-house plant, but it had become apparent that the economical limits of their present system of direct-current generation had been reached. In view of the present position and of prospective future developments, they had now decided to install an additional set of 600-kw. capacity, which would generate alternating current at about 5,000 volts for transmission to a substation to be erected on their land at Epsom, where it would be transformed to direct current and distributed to the southern portions of their lines. That would relieve their low tension distributing mains within the City of much of the work they at present had to perform, and would conduce to greater efficiency and greater economy in current consumption. Other considerable improvements and additions were in course of being carried out at the power station, which would be much enlarged. An additional boiler was being erected, and they were installing an up-to-date system of automatic coal-handling machinery. New circulating water-pumps of greater capacity were being provided, and, in addition, they were enlarging their two car depôts and remodelling and extending their repair shops. The necessary funds for those works would be provided by the new issue of shares which had been lately made, and they looked to see a remunerative return on the outlay in the shape of a reduction in the working expenses. The total revenue for the year amounted to £165,655, as against £140,451 in 1907, an increase of £25,204. On the other hand, the aggregate expenses were about £18,000 more. Power and running showed an increase of £14,553, which was due to the largely increased car-mileage run and, to a greater extent, to the increased cost of coal, which, he was afraid, was likely to be of a permanent character. On repairs and renewals they spent £24,827, or £4,477 more than in 1907. A good deal of that money was spent upon cars, principally upon the electrical equipment. They hoped the expenditure would not be continuous to the same extent, but it would clearly be an unwise policy to limit it to the detriment of efficiency. The net results were somewhat better than the figures indicated, for although the allocation to the reserve fund and the ordinary dividend were at the same rate as last year, they had put £2,500 more to the depreciation account, the preference dividend was £342 more, and they had paid £2,274 more in debenture and other interest, and they also carried forward £1,755 more into the current year's accounts. The traffic receipts continued to show very gratifying expansion. The amount received last year was an increase of £26,129 over the previous year, and was equal to nearly £7,400 per route-mile open at the end of the year. Last year's figures, however, did not include the full year's working of the Mount Eden extensions of 3½ miles, one-half of them being opened on May 16th, and the remainder not until August 27th. It was satisfactory to know that those extensions were maintaining the average revenue producing capacity of the older lines, and that while they ran 240,000 more miles, an increase of 10 per cent. on the previous year, and carried 3,670,000 more passengers, or a total of over 26 millions, the receipts per car-mile showed a substantial increase. The growth of the traffic was so remarkable as to call for more than a passing notice. The population of the city and district of Auckland which their tramways served was about 80,000, and during last year they carried that population nearly 330 times, very nearly approaching carrying the whole of the population in one day. The growth still continued, for in the first four months of the present year the traffic receipts showed an increase of £6,800 over the corresponding period of 1908. On the occasion of the visit of the American fleet to Auckland last year, the traffic for the week surpassed all their previous records, and he was almost inclined to think it constituted a record in tramway business. On one day the number of passengers carried was over 148,000, and during the week they carried a total of nearly 900,000, resulting in traffic receipts of over £6,000. That this exceptional traffic was handled without mishap or accident of any kind spoke well not only for the efficiency of the system, but equally for the careful and intelligent work of their men and reflected great credit upon their general manager and his staff. During the year the New Zealand Government appointed a Commission to inquire into the question of the brakes with which their cars were equipped, and the Public Works Department had called upon them to take steps to have a more efficient system of brakes installed, and to submit to the Department for approval full details of the brake they proposed to adopt. While the company still contended that their present brake system was efficient and well suited for the conditions of their traffic—a contention which their freedom from accident attributable to brake failures went far to substantiate—they desired to meet the views of the Department in every possible and reasonable way, and they recognised that it was to the interests of the company, as well as to the interests of the public, that the best and safest form of brake should be used. Though the matter had been the subject of considerable controversy and discussion in all parts of the world where tramcars were used, no definite conclusion had yet been arrived at as to what was the best and safest form of brake; and, apart altogether from the very considerable cost, they hesitated to supplant their present system of brakes by something which might be a source of danger instead of an additional safeguard. With the concurrence of the Department they were equipping two of their cars with the latest improved type of air brake, with a view of ascertaining by actual experience whether that type of brake would be suitable to their Auckland conditions. In conclusion, the chairman said he was glad to say that the company's relations with its men were perfectly harmonious, and he referred to a visit he had paid last year to New Zealand in the company's interests.

Mr. C. S. Hilton seconded the motion.

Mr. E. Garcke congratulated the directors upon the satisfactory nature of the report, and said that for the harmonious relations which now existed between the company and its men they were very greatly indebted to the influence which the chairman had brought to bear in the matter. The financial position of the company was exceedingly strong, and it was easy to see that the board could have paid a larger dividend had they wanted to. He thought they were wise to increase the reserves instead, which now amounted to £67,000, which was practically 10 per cent. of the total paid-up share and debenture capital, which, considering the tenure of the company and the terms of purchase which applied to it, was a very strong reserve.

The report was adopted.

West India Electric Co.—The net profits for the year 1908 were $76,355·74, or 9·53 per cent., an increase of $3·40 per cent. over 1907. Gross earnings were:—$217,410·55; operating expenses, $92,040·01; net earnings, $125,370·54; interest on bonds, $30,000; tax on railway receipts, $7,044·80; rental, $12,000. Four quarterly dividends have been distributed, leaving a credit at profit and loss of $275,440·31. Street railway receipts increased by $2,030 92, lighting by $16,372·80, and miscellaneous by $151·43. Operating expenses decreased from 47·87 per cent. to 42·33 per cent.

National Electric Construction Co., Ltd.

The meeting was held on Friday at Winchester House, Mr. L. B. Schlesinger presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, April 30th, page 730), said that the depression in the electrical industry had continued during the past year, thus making it useless to attempt to finance tramway schemes. Notwithstanding that the results were not unsatisfactory except for the fact that they declared no dividend. They were carrying forward a substantial balance, which would enable a 5 per cent. dividend to be paid directly the finances of the company permitted it. Turning to the undertakings in which the company were interested. There was no improvement in the receipts at Musselburgh, although the profits on the tramways were slightly better; that line had carried 2,234,065 passengers, as compared with 2,169,631 in 1907, showing that the short-distance traffic was increasing. Financial arrangements had now been completed for extending the tramways to Port Seton, and the directors believed that the extension would result in an increase of the profits—sufficient, they hoped, not only to pay the dividend on the preference shares, but to build up a strong reserve, and eventually pay a dividend on the ordinary shares. The receipts on the Rhondda tramways were very satisfactory; the number of passengers carried was 3,327,622; the average receipts per car-mile, 12·20d.; and the average receipts per passenger, 1·32d. Since the beginning of the year up to April 15th, over £13,000 had already been taken. As to the Mexborough and Swinton line, the overhead system was completed and working by August 29th, with the result that there had been a substantial increase in the receipts, and a corresponding decrease in expenses. The directors believed this undertaking would be a dividend-paying one by the end of the year. The heavy expense of the surface-contact system was hampering the progress of the Torquay tramways. Agreements had been made with the Torquay Corporation and the Paignton U.D.C., for the extension of the tramways to Paignton, and there was no reason why Parliament should not sanction the powers. The overhead system would be installed on the line. The receipts at Torquay for last year amounted to over £15,000. He was glad to say that satisfactory terms had been arranged with the Oxford Corporation, whereby only a small portion of the tramways to be electrified would be constructed on the conduit system, and the rest on the overhead system. The City of Oxford Electric Tramways Co. had a Bill before Parliament which would be unopposed. A Bill had been promoted by the Folkestone, Sandgate and Hythe Tramways Co., so as to allow of the overhead system being used on part of their route. The local authorities were opposing the Bill, and were asking for the conduit system. It was rather a significant fact that during the last two or or three years very few tramway Bills had been promoted, and that was probably due almost entirely to the fact that local authorities used their powers unfairly. Very many districts throughout the country could support inter-urban tramways, if they could be built at a reasonable cost, and while the local authorities were in many cases anxious for electric tramways, not only would they not take the risk themselves, but the conditions they made were practically prohibitive. That was a great contrast to the support given to tramway schemes abroad; it was also an instance of how British capital was forced abroad. It was a short-sighted policy, but it would continue until the local authorities really encouraged and facilitated the carrying out of enterprises which were to benefit their districts. In this connection he could only say that they, as a company, would not again attempt the promotion of tramways in this country under present conditions. The Dewsbury, Ossett and Soothill Nether tramways, built and completed by the company last year, were opened on November 11th, and the results were encouraging. The two lighting industries in which they were interested—Bo'ness and Carnarvon—were making good progress. Dealing with the accounts, they showed a gross profit for the year of £31,348, and deducting therefrom expenses of administration, debenture interest, &c., there remained a balance of £18,979, as compared with £18,116 last year. That sum had been transferred to reserve and depreciation, with the exception of £612, which had been carried forward. As to the future, they had some important negotiations in hand, and were hopeful of obtaining one or two contracts shortly, which would result in satisfactory profits to the company.

Mr. J. Carr Saunders seconded the motion, and the report was adopted without discussion.

Oriental Telephone and Electric Co., Ltd.

Mr. B. St. John Ackers presided at the Great Eastern Hotel, on Wednesday, over the ordinary general meeting.

In moving the adoption of the report (see Electrical Review, April 23rd, page 689), the Chairman said that the past year had, as they knew, had been one of general depression in every branch of trade, and this company had not escaped being affected by it, but only in the sense that the increase in revenue and profits was not so large, as would have been the case under normal conditions. They had, therefore, much pleasure in being able to propose the same dividend as last year, viz., 8 per cent., which, however, even in prosperous times, was a very handsome one. On the other hand, they proposed to carry forward a larger sum than ever they did before, *i.e.*, over £5,000. Their advices and receipts since the beginning of the present year had been encouraging, and as trade was gradually improving in all those countries with which they had business relations, they looked forward to still better results in the present year. Egypt again led the increase in revenue, but next to it came Calcutta, which had shown an unwonted activity, the additions to the number of subscribers continuing uninterruptedly. Not only had the additional lines provided by the reconstruction of the whole system been all taken up, but extensions in various directions had become necessary, for which, under their agreement with the Bengal Telephone Co., they provided the materials and funds. So far only £5,000 had been added to the company's debenture debt to them, but more would have to follow. There was, however, no reasonable doubt that their increased revenue would not only enable them to pay a larger dividend in future, but eventually to reduce their contributions to their capital outlays. One of the great drawbacks to more extensive development of telephone enterprise in India was that the Government provided their own telephone service, which was on a large scale. They had not only applied, but in several instances obtained, authorisation to introduce a telephone service in various other centres in India and Burmah, such as Bangalore, Madura, Mandalay, and so forth, but without the support of Government lines and their subscriptions they found that the number of subscribers amongst the public was not sufficient to justify them in installing and maintaining telephone exchanges in those places. So far, therefore, they had had to rely exclusively on the support of the general public, but they now heard with pleasure that the Bengal Telephone Co. was in very promising negotiations with both the Government and the Commercial Communities of the newly created Eastern Bengal province, the chief seat of which was Dacca, and that a new field for telephone enterprise would probably be open there shortly. As they were aware, the Bengal Co. owned the privileges for telephones over this province, and as their company was very largely interested in the Bengal Co., holding, besides the whole of the debenture debt, more than one half of its shares, this new opening would be of great importance and benefit to this company, Dacca being the centre of the Indian jute and hide trades. They were giving close attention to any prospects there might be to extend the sphere of their operations in the East, but they must first be satisfied that any new move was of a remunerative and permanent nature before they entered upon it. There was every indication also of a revival in their other telephone exchanges at Madras, Rangoon and Singapore, as well as in Bombay, and it was really more in the sale of electrical material that they had felt the effect of diminished trade during the past year than in the telephone business itself. The chairman proceeded to read a letter from Mr. Gibbons, who was sent out by the board to superintend the reconstruction of the company's exchanges in the East. Mr. Gibbons said the plant was now in the highest state of efficiency, and the staff would be in a position to handle a much larger traffic. Continuing, the chairman said that the China and Japan Telephone Co. had at present full employment for all the capital they could spare, both in Hong Kong and Kowloon, but when the Kowloon-Canton Railway, which was now in course of construction, was finished, they might expect that company to extent their sphere of activity considerably in the direction of, and probably to, Canton. In Mauritius they were now negotiating with the Government for a concession to provide the whole island with a telephone service instead of Port Louis alone as heretofore, and they hoped to have something favourable to say on this subject in their next report. Again they had to acknowledge the loyal co-operation of their staff. Not a few had been in the company's service for very many years, and were entitled to share the credit of the company's present prosperous condition. The pension scheme mentioned last year was being elaborated, and they hoped to submit some definite proposals next year. Mr. Chalmers, who had held the secretaryship of this and the two allied companies for nearly twenty-five years, had retired through ill-health and had been succeeded by Mr. Macleod, who held an equally long record in the company's service.

Mr. H. Grewing seconded the motion.

Replying to questions raised, the Chairman said the board were well aware that there were a number of large towns in India, and they had constantly before them the question of whether telephone exchanges could be profitably opened in them. At the same time it was the Bengal and the Bombay companies which had the concessions for India, and it would be for one of these two companies to start exchanges.

The report was then agreed to.

The Italian Thomson-Houston Co.—The report for 1908 of the A.E.G. Thomson-Houston, Società Italiana di Elettricità, of Milan, states that the railway between Padua and Fusina, equipped by the company for the Società Veneta, which was the first in Italy on the single-phase system, had been completed and set in operation. As a consequence of the conclusion of large contracts, especially for the hydro-electric works on the Adamello, the orders brought over from 1908 into the present year were not less than the carry forward from 1907 into 1908. During the year the company acquired the site of the Zust automobile works in Milan, and the construction of machinery therein has already been commenced. The gross profits earned in 1908 amounted to £65,800, as compared with £59,410 in the preceding year, and the net profits were £23,120, and £21,440 in the same years respectively. The greater profits are attributed to the large orders brought forward from 1907, and the increase in the share capital, which enabled the business to be conducted more energetically, although the crisis still continuing made itself unfavourably noticeable in many branches of industry. It is proposed to pay a dividend of 6 per cent. on a share capital of £360,000, as compared with a similar rate on £240,000 in 1907. The report adds that in consequence of the financial and political situation, it is difficult to forecast the course of business during the current year, although satisfactory results are hoped for in the absence of extraordinary disturbances.

Wolverhampton District Electric Tramways, Ltd.

The meeting of this company was held on Thursday of last week, at the Electrical Federation Offices, Kingsway, Mr. S. R. Blundstone in the chair.

In proposing the adoption of the report (see Electrical Review, April 30th, page 731), the Chairman said that the company's tramways had been seriously affected during the past year by the unfortunate trade depression that had existed in the Black Country. The traffic receipts showed a shrinkage of £1,266, or about 5 per cent. on the total compared with the previous year. Every endeavour had been made by varying the fares and stages to meet the altered circumstances brought about by the depressed state of trade, and the loss to some extent was so prevented from being greater. The number of passengers carried was less by 330,000 than in the previous year, and the receipts per car-mile decreased ·59d. With a view to maintaining the receipts and the average fare, the issue of children's ½d. tickets was discontinued, and this accounted for a very large decrease in the passengers carried. Children's tickets had been reintroduced in the Bilston district with a view to seeing whether any improvement in the receipts was possible. The receipts for advertising, he was glad to say, showed a slight improvement. As to the expenses, there was a small decrease in the cost of power and running, while the cost of repairs and maintenance had gone up to the extent of £500, due, principally, to the repairs to the track necessitated by mining subsidences. An appropriation of £500 had been made by the directors to the renewals fund, compared with £1,000 in 1907, while the amount chargeable against that fund during the year was £93. Some economies had been effected in the administration and general expenses, excepting in the item of rates and taxes, which showed an increase of 5 per cent. With regard to the capital account, that had been slightly increased during the year, in consequence of certain road alterations on a section of the line. The total capital expenditure was now £5,470 in excess of the capital issued. That could easily be put in order on the receipt of the purchase money from the tramways recently sold to the Dudley Corporation, which it was expected would be received during the present year. He regretted that the profits did not admit of such a large sum being set aside to the depreciation and reserve and renewal funds as in the previous year, and they had not thought it necessary, in view of the anticipated receipt of the Dudley purchase money, to credit any sum this year to the sinking fund accounts. The arrangements made with the Wolverhampton Corporation for the provision of through services into Wolverhampton, with cars equipped with skates for the surface-contact system and trolleys for the overhead system, had not proved satisfactory, and were, in fact, a source of loss to the company. The arrangements had consequently been terminated on January 9th.

Mr. G. A. Lycett seconded the motion, and the report was adopted.

Chiswick Electricity Supply Corporation, Ltd.

The annual meeting was held on Monday at 14, Ironmonger Lane, E.C., Sir Thomas Brooke-Hitching presiding.

In moving the adoption of the report (see Electrical Review, April 30th, page 729), the Chairman referred to the pleasant character of the report. The company was making sure and steady progress, and during the past year they had made provision for such capital as they might require during the next few years on very reasonable terms, and, therefore, the board had no worry on that item. Since he last addressed them, the metallic-filament lamp was being largely used, and by its adoption the price of electricity was brought down as low as that of gas. He thought the lamp would give a fillip to the electrical industry, and they could regard it as a blessing in disguise. They had a good field in Chiswick for the supply of electricity, and it was only yet very partially developed. In due time, he had no doubt, when the district was more fully developed, it would bring in an increased revenue to the company. Since the fight before the Parliamentary Committees last year, and the year before, the electrical undertakings had been placed in a more substantial position. As they knew, both the Chiswick and Aberystwyth undertakings had been acquired from their respective local authorities, and when they were repurchased, the authorities were under an obligation to buy them on the basis of a profit-making concern.

Mr. W. B. Esson seconded the motion, and the report was adopted.

Dudley, Stourbridge and District Electric Traction Co., Ltd.

The meeting was held on Thursday of last week, at the Electrical Federation Offices, Kingsway. Mr. S. R. Blundstone, in proposing the adoption of the report (see Electrical Review, April 30th, page 731), said that in common with all the tramways in the district, there had been a considerable shrinkage in the traffic receipts due to the very depressed trade conditions that had prevailed. The decrease amounted to £2,777. Owing to the necessity for maintaining the services in the highest condition of efficiency it had not been possible to effect any savings in the expenses, which were £434 more than the previous year. The effect on the company's business owing to the depressed state of trade was seen in the number of passengers carried. They had fallen off by about 9 per cent. or 653,000 in number, and the average receipt per car-mile was less by ·549d. The decrease was principally on the main line from Dudley to Stourbridge and on the Cradley Heath line, while the receipts taken on the Kinver light railway were less by £714 as compared with the previous year. There was no doubt that some portion of this decrease was due to the withdrawal of the half fares for children, by which 462,409 passengers were lost. Arrangements were being made on the various sections to re-introduce children's fares, to see what the result would be. No reduction had been possible in the expenses for power and running, and the cost of repairs and maintenance was responsible for £131 of the total increase in expenses. Under the head of administration and general expenses there was an increase in the rates and taxes, and also of £45 in insurance. The directors had followed the usual course of providing for renewals before arriving at the profit, and they had included in the accounts £1,000 for that purpose, making the funds £5,859, and so reducing the divisible profit to £6,136, out of which they recommended that £1,000 be placed to the sinking fund, and £1,000 to the depreciation and reserve fund, as was done in the previous year. The various reserves now amounted to £38,000. There had been some rather expensive renewals to the track during the year which cost £1,141, which had been charged against the renewals fund. The agreement with the Dudley Corporation as to the lease and the amount payable had been negotiated with great difficulty, and although the terms finally settled were sufficiently onerous, it was hoped that by the development of the traffic during the period of the lease and the investment of the purchase-money in the acquisition of the Kinver light railway, the final result of the arrangement would not be to prejudice the company. He was pleased to say that the parcels and goods services had developed very well during the year, the receipts from that source having amounted to £146, as against £96 in 1907.

Mr. G. A. Lycett seconded the motion, which was agreed to.

Lisbon Electric Tramways, Ltd.

The directors' report for 1908 shows that the result of the company's operations for the past year, after deducting interest and amortisation due on the debentures of the "Companhia Carris de Ferro de Lisboa," and after the payment of £25,000 for interest on the debentures of this company, and also the payment of London office expenses and directors' remuneration, shows a net profit of £89,863, which, added to the amount of £12,011 brought forward, gives a balance of £101,875. £35,000 has been placed to depreciation reserve, and £5,000 to the credit of exchange reserve account. There remains £61,875, out of which the usual preference dividend, £25,533, has been paid, and a dividend of 5 per cent. is recommended for 1908, amounting to £31,701 on the ordinary share capital, leaving £4,640 to be carried forward. The traffic operations are satisfactory, and show an increase of Rs. 26,540.144, but owing to the fall in the rate of exchange the net result in English currency is a decrease of £2,717. Had the rate of exchange remained as in 1907, the profits for 1908 would have amounted to about £12,000 more than shown by the profit and loss account. The Elevador Do Carmo, which is leased by this company, continues to give satisfactory results. During the year 1908, the directors purchased an interest in the "Nova Companhia dos Ascensores Mechanicos de Lisboa." This investment was made not so much with the view of increasing profits, but because its acquisition tends to consolidate the system, and enables the company to offer greater facilities to the travelling public. The above investment necessitated the issue of 36,528 ordinary shares of the company during the year under review. The board record the death, on March 29th, 1909, of Count Henry De Burnay, one of the original founders of the Lisbon Electric Tramways, Ltd., who has been a director of the company for many years. The directors record their appreciation of the services rendered to the company by the members of the Local Board in Lisbon, by Mr. William Clark, the general manager and chief engineer, and by the entire staff.

The Lombardy Company for the Distribution of Electrical Energy.—At the annual general meeting of this company the directors reported having sold in 1908 electricity to the value of 5 325,906 lire, an increase of 1,130,104 lire. The installation at Vizzola has worked with perfect regularity under the direction of Eng. Scotti. The shares, which have a face value of 500 lire, received a dividend of 55 lire, or 11 per cent., against 10 per cent. last year. The working costs amounted to 2,550,571 lire; rent, rates and taxes, to 408,435 lire; depreciation account, to 500,000 lire.

Alderley and Wilmslow Electric Supply, Ltd.—The directors' report for 1908 states that further progress has been made, the total connections being increased from an equivalent of 16,269 to 17,725 8-c.p. lamps. The result of the year's working shows a profit of £1,745, and after wiping off the adverse balance of £2 10s. from last year's accounts, and paying interest on debentures and loans amounting to £1,178, there remains a balance of £564, of which the directors recommend that £500 should be put to a reserve fund for renewal of plant, £64 being carried forward.

American District Telegraph Co.—A surplus of $785,881 for the year ending December 31st, 1908, is shown in the accounts. Dividends absorbed $398,088, and the amount at credit of profit and loss account is $1,632,737.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	April 28	2,558	+ 93	48	64,672	+ 3	..	..
Ayr	May 1	498	— 84	50	13,962	— 366	8	..
Bath	April 28	1,451	— 174	17	10,759	+ 431	..	..
Belfast	,, 30	7,343	— 550	4	16,589	+ 422	37	..
Birkenhead	May 2	2,044	— 104	4	4,747	— 107	18·52	..
Birmingham Corp.	April 24	13,488	+ 488	4	23,263	+ 66	..	..
Blackpool-Fleetw'd	May 1	773	— 413	17	5,508	+ 564	..	..
†Bolton	April 25	2,209	— 90	4	9,106	— 95	26	..
Bournemouth	,, 28	3,363	— 697	4	7,295	+ 22	21·96	..
Bradford	,, 24	10,389	+ 138	4	17,525	+ 397	54·9	..
Brighton	May 2	1,728	+ 4	5	4,302	..	9·5	..
Bristol	April 30	10,283	— 378	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	,, 23	451	+ 4	16	3,427	— 69	3·65	..
Barnsley	,, 23	374	— 48	,,	2,695	— 82	..	..
Barrow	,, 23	481	— 77	,,	3,293	— 276	5·37	..
Cavehill	,, 23	269	— 114	,,	1,094	— 167	..	..
Devonport	,, 23	763	— 235	,,	5,894	— 104	8·85	..
Gateshead	,, 23	2,050	— 59	,,	15,628	— 165	11·25	..
Gravesend	,, 23	466	+ 28	,,	2,911	— 120	6·5	..
Greenock	,, 23	1,173	+ 39	,,	7,424	— 176	7·25	..
Hartlepool	,, 23	470	+ 19	,,	3,217	— 155	6·72	..
Kidderminster	,, 23	243	+ 2	,,	1,352	— 58	..	..
Leamington	,, 23	380	+ 18	,,	2,354	+ 165	..	..
Merthyr	,, 23	511	— 18	,,	3,268	+ 9	2·9	..
Metropolitan	,, 23	13,765	+1,805	,,	88,227	+ 9,880	22	..
Middleton	,, 23	787	— 128	,,	4,894	— 243	8·5	..
Mid. Joint Com'tee	,, 23	12,607	+ 220	,,	85,775	— 2,054	..	..
Oldham—Ashton	,, 23	1,260	— 209	,,	8,637	— 685	9·18	..
Peterborough	,, 23	269	— 116	,,	1,624	— 101	5·31	..
Potteries	,, 23	3,680	— 111	,,	27,828	— 1,166	29	..
Rothesay	,, 23	477	— 16	,,	1,164	— 17	2·75	..
Southport	,, 23	694	+ 3	,,	3,748	+ 123	8·17	..
S. Metropolitan	,, 23	1,861	+ 187	,,	11,471	+ 317	..	..
Swansea	,, 23	2,049	+ 53	,,	14,080	+ 349	12·5	..
Tynemouth	,, 23	403	+ 17	,,	2,254	— 107	3·75	..
Weston-s-Mare	,, 23	286	+ 67	,,	668	+ 95	3	..
‡Worcester	,, 23	109	+ 20	,,	3,831	— 4	5·75	..
Wrexham	,, 23	238	— 31	,,	1,480	— 45	..	..
Yorks. Wool. Dist.	,, 23	1,989	— 124	,,	13,565	— 493	17	..
Miscellaneous	,, 23	442	— 4	,,	2,941	— 16	..	..
Burnley	May 1	2,448	+ 53	..	..	..	..	..
Burton-on-Trent	,, 2	616	— 24	5	1,225	+ 17	10	..
Bury	,, 2	2,221	— 6	4½	5,665	— 33	22·5	..
†Cardiff	April 24	2,089	— 220	4	7,677	+ 34	..	..
Carlisle	May 1	533	— 9	17	2,572	— 16	..	..
Chatham and Dist.	April 29	1,668	— 152	17	12,864	+ 1,319	14·98	2·77
Cork	,, 29	826	— 37	17	7,158	+ 287	..	..
Croydon	,, 30	2,868	— 82	..	6,599	+ 574	11·25	·75
Darlington	,, 24	378	— 62	4	743	— 41	..	..
Darwen	,, 20	477	— 20	4	1,115	— 23	4·36	..
Dover	,, 24	397	— 17	4	707	+ 13	4·75	..
Dublin	,, 30	10,928	+ 168	..	84,033	+ 1,131	54·25	..
Dundee	,, 28	2,315	— 46	4⅝	58,977	+ 2,102	15	..
East Ham	May 1	1,978	+ 314	4½	4,531	+ 832	8·43	·68
Exeter	April 30	595	— 63	5	1,405	+ 85	5·5	..
Glasgow	May 1	34,771	— 31	..	812,887	—16,908	90·5	1·5
Hastings	April 29	1,959	— 542	..	..	..	..	..
†Huddersfield	,, 24	1,574	— 480	3	6,103	+ 329	..	..
Hull	May 1	4,897	+ 41	4	11,401	+ 113	13	..
Ilkeston	April 28	240	— 3	4	541	+ 6	..	..
†Ipswich	,, 24	358	— 7	..	1,361	+ 142	10·5	..
Kilmarnock	,, 24	290	— 4	49	7,281	— 356	4·25	..
Lan'kshire Trm. Co.	,, 29	2,549	— 288	17	20,275	— 1,321	17	1·18
Lancashire United	,, 28	2,409	+ 895	17	20 920	+ 341	..	..
†Leeds	,, 17	7,272	+ 738	3	17,2.0	+ 2,203	96·75	·25
Leicester	May 1	4,295	— 249	..	..	..	..	..
Leith	April 24	1,010	+ 55	49⅔	25,476	+ 71	6	..
Liverpool	,, 24	21,783	+ 99	16⅔	169,116	— 551	104	..
‡L.C.C.	,, 17	72,265	+8,990	..	88,649	+10,513	121	4·25
London United	May 1	11,690	—1,488	..	90,089	— 4,515	..	..
Manchester	,, 1	29,259	— 642	4	67,803	+ 2,381	90·5	6
Newcastle	,, 1	7.489	— 312	..	17,813	+ 23	..	..
Newport	April 24	1,320	— 45	4	2,667	+ 66	14·5	..
Oldham	May 1	3,696	— 259	5	10,909	— 420	23·75	..
Pontypridd	,, 1	783	— 42	1½	2,071	+ 336	5·5	1·75
Portsmouth	..	..	..	..	..	..	14·5	..
Preston	April 28	1,487	— 88	..	..	..	..	..
Rotherham	,, 29	1,152	— 156	4	2,567	— 30	10	·66
Salford	,, 26	8,788	—1,099	35	17,369	+ 256	..	..
Sheffield	May 2	10,053	+ 13	5⅔	80,428	— 50	87	1·25
Southampton	April 28	2,010	+ 24	4	4,166	+ 381	..	..
Southend-on-Sea	,, 28	884	+ 34	4	1,842	+ 417	..	..
South Shields	May 1	1,029	— 2	4⅔	2,471	+ 162	..	..
†Swindon	April 21	121	— 47	..	..	..	..	..
Tynemouth	,, 28	771	— 273	17	6,779	+ 488	..	..
Wallasey	,, 24	1,946	+ 157	33	3,316	+ 273	..	·22
Walthamstow	May 1	1,213	+ 40	5	3,030	+ 497	9	..
†West Ham	April 22	5,151	+ 609	3	7,664	+ 500	15	·3
Wolverhampton	,, 28	1,503	— 367	4	3,277	— 107	12·5	..
Baker St.-Waterloo	May 1	6,715	+ 160	17	57,445	+ 5,155	4·25	..
Cen. London Rly.	,, 1	10,802	— 416	17	99,384	— 8,136	6 32	·55
Char. +, Eus. Hamp.	,, 1	7,855	+ 960	17	65,400	+11,275	7.75	..
City & S. Lon. Rly.	,, 2	6,311	— 288	17	56,361	+ 444	7·8	..
†Dublin-Lucan Rly.	April 23	136	— 48	16	1,810	+ 129	7	..
G.N. and City Rly.	May 1	2 922	— 312	17	26,316	— 3,217	3·5	..
G.N., P'y. & Brmtn.	,, 1	11,610	+ 545	17	98,765	+ 6,825	9·25	..
L'pool Overh'd Rly.	,, 2	2,635	— 288	17	23,301	— 1,688	6·8	4·3
Mersey Railway	,, 1	3,966	+ 47	17	33,334	+ 787	4·5	..
Metropolitan Rly.	,, 2	22,607	+ 885	17	207,779	+ 7,949	24·5	..
Met. District Rly.	,, 1	19,812	+2,589	17	165,255	+14,631	24	..
Anglo-Argentine	April 29	82,881	+11,219	17	678,528	+47,730	..	..
§Auckland	Mar. 26	18,566	+2,444	12	41,824	+ 4,724	..	..
Bombay (B.E.T.)	April 1	5,193	+ 361	13	33,331	+ 2,497	..	..
§Brisbane	March	16.000	+1,510	12	45,330	+ 3,110	..	..
Calcutta	May 1	6,116	+ 103	..	..	..	..	..
§CapeElectricT.Ld.	March	13,179	..	..	..	..	..	..
§Kalgoorlie, W.A.	,,	4,188	..	12	11,306	..	20·5	..
Madras	April 30	1.224	— 20	17	10,401	+ 142	..	..
§Melbourne	April	47,000	..	..	..	..	..	..
§Lisbon	March	25,726	..	..	..	..	..	..
Perth (W.A.)	April 30	2,788	— 171	17	25,200	+ 94	26	2·4

* Compared with the corresponding period of 1908. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

INVESTMENT business in the Stock Exchange is, on the whole, expanding, and prices are in a cheerful frame of mind. The Budget has been rather an aid to improvement in prices, the Stock Exchange getting off more cheaply than was expected by some who looked for a bigger inroad upon the sinking fund, coupled with a new Navy Loan. Incidentally, it is a little amusing to hear the savage denunciations of a Budget in which its traducers find some difficulty to lay hold of definite points for rational—as distinct from journalistic and partisan—criticism.

The prices most affected in our price-lists by the Budget are those of the underground railway stocks. Central London Preferred, Deferred and Ordinary are up 2, 3 and 4 points respectively. Metropolitan Consolidated gained 1½, Districts ⅜, Piccadilly Debenture 1, and Underground Electric Railways bonds 1½. All these movements are connected with the Chancellor of the Exchequer's new tax on petrol. This, the market seems to suppose, will lead to a revision of fares on motor-omnibuses, thereby occasioning a possible reversion of passengers to the railways. The opening of the Earl's Court Exhibition this week, and of the Franco-British soon afterwards, is another bull point in favour of the Central London, Metropolitan and District stocks. City and South London Ordinary remains at 31.

Electricity Supply issues relapsed into stagnation once again, and there is next to nothing doing in this department. Smithfields Ordinary shares have gone back to 15s.; but South Metropolitans, which were overlooked in last week's advance amongst the lower-priced shares, are 1s. 3d. better. Westminsters fell ⅛, and other Metropolitan shares show no change. Some of the Debenture stocks are slightly better.

The Canadian-Mexican group is animated but irregular. Mexican Light and Power Common is down 1, and the Preference stock, *ex* the dividend, shows a fall of 2. Mexican Electric Light 5 per cent. bonds go steadily better, and have gained 1. Mexico Trams bonds, recommended here several times, are another 1½ up, at 86½; while the Common stock at 148 is 6 better, the dividend accounting for part of this. Rio Trams jumped up 3½, to 105½; Sao Paulos rose 1, to 157. Canadian General Preference at 120 is 2 up, although the capital stock at 124 is 1 lower.

Wild speculation in Anglo-American Telegraph Deferred stock rushed up the price to 18⅜, from which there was a small reaction, which still left the stock very much to the good on balance. It is said that the company did exceedingly well over the wheat gamble in the United States, and that the traffics so far have benefited to a large extent from the prolonged activity in the market for American Rails. Another reason given is that some of the competing cables have recently been "down," but if this is the case, the shares of the competitors have not reflected any such accidents. Both the Ordinary and the Preferred stocks are 2 points higher. Direct United States Cable shares are 15s. better, and Commercial Cable 4 per cent. Debenture gained 1. American Telephone and Telegraph stock pursues its ascent. Cuba Telegraphs are up 10s. Eastern Extensions have put on another ¼, while Eastern Telegraph stock held to 13½, the group being firm. Indo-Europeans, marked *ex* 52s. 6d., have receded £2, and West India and Panama Preferences are decidedly better. The rise in these last is due to dividend anticipation. Mackay Companies' stocks rose substantially. Globes are unchanged.

From remarks made by Mr. Sydney Buxton in the House of Commons, it is supposed that the National Telephone Co. may become Government property before the appointed sands are fully run. If so, argues the market, it would mean better terms than the undertaking might otherwise hope to receive, and consequently there has been spirited bidding for the Deferred. At 124 the stock is 2½ higher, and the Third Preference have been run up to 5⅞, a ⅞ rise. Monte Video Ordinary and Preference are both *ex* dividend, the prices being left unaltered, while in Oriental Telephone shares the deductions are more clearly exhibited.

Anglo-Argentine Tramway shares have advanced, and the 4 per cent Debenture rose 1½, to 93. The stock, which bears interest only from last February, is quoted at a point less, and the fully-paid scrip stands at 91½. British Columbia Railway stocks are good; and Calcutta Ordinary, *ex* 2s., are still quoted at 4½ *ex* middle.

With the subsidence of the Navy excitement, armament shares came on offer, Vickers and Armstrongs both easing off a little. Babcock Ordinary, allowing for the dividend, are better on the week, though the Preference show a trifling decline. Castner-Kellners have been a good spot. Willans & Robinson Ordinary shaded off to 1⅛, the Debenture stock at 80 retaining its rise, in expectation of the company being a further buyer.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1905.	1906.	1907.	1908.	Closing Quotations April 27th.	Closing Quotations May 4th.	Business done week ended May 4th, 1909. Highest.	Lowest.	Rise + or Fall −	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2⅜ — 3⅛	2⅜ — 3⅛	..	..	..	Nil.
136,700	Do. do. 5 % Debs., Nos. 1 to 1,350 Red.	100	5 %	5 %	5 %	5 %	92 — 95	92 — 95	..	..	..	5 6 5
$181,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7¾ %	8 %	8 %	8 %	143½ — 144½	144 — 145	144⅞	144½	+ ⅜	5 10 4
$58,000,000	Do. Collat. Trust, 4 % Bonds, 1 to 23,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	98 — 100	98 — 100	..	..	..	4 0 0
598,180	Anglo-American Telegraph	Stock	3½ %	3⅞ %	3½ %	£3 4s.	56 — 59	58 — 61	58½	..	+2	5 6 10
3,200,910	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	100 — 102	102 — 104	103⅝	102½	+2	5 15 5
3,200,910	Do. do. do. Deferred	Stock	1½ %	1⅝ %	1 %	8/-	16½ — 16¾	17⅜ — 17⅝	18⅝	16½	+1½	1 7 6
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	98 — 100	98 — 100	..	..	..	5 0 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	8 — 8¼	8 — 8½	..	..	..	4 14 1
2,481,360	Commercial Cable Sting. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	90 — 92	91 — 93	94⅛	90⅞	+1	4 6 0
16,000	Cuba Telegraph	10	5 %	5 %	6 %	6 %	7⅞ — 8¼	8 — 9	8⅛	8¼	+ ⅛	6 13 4
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17 — 18	17 — 18	..	..	..	5 11 1
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8 — 8¼	8 — 9¼	..	..	..	5 14 2
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½ — 9	8½ — 9½	..	..	..	5 8 1
80,000	Do. do. 4½ % Debs.	20	4½ %	4½ %	4½ %	4½ %	100 — 102	100 — 102	..	..	..	8 16 6
60,710	Direct United States Cable	20	4½ %	4½ %	4½ %	4½ %	12⅜ — 12⅞	12⅜ — 13⅛	13⅜	12¼	+ ⅜	6 8 4
48,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½ %	4½ %	4½ %	4½ %	100 — 102	100 — 102	102⅜	..	..	4 8 9
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	134 — 137	134 — 137	1.6	134½	..	5 2 2
2,000,000	Do. 5½ % Pref. Stock..	100	5½ %	5½ %	5½ %	5½ %	85 — 87	85 — 87	86½	..	..	4 0 6
1,896,708	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	104½ — 106½	102½ — 104½xd	..	..	..	4 6 2
900,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	7 %	12½ — 12¾	12¾ — 13	12⅝	12½	+ ¼	5 7 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 — 103	101 — 103	101⅜	99½	..	3 17 5
900,000	East & S. Afric. Tel., 4 % Mt. Db. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 — 103	.. — ..	..	..	..	3 17 8
181,127	Globe Telegraph and Trust	10	5¾ %	5¾ %	5¾ %	..	10⅝ — 11⅛	10⅝ — 11⅛	11	10⅜	..	5 8 11
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	..	12⅜ — 12¾	12⅜ — 12¾	13⅛	12⅜	..	4 10 7
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	24%	20 %	20 %	18%	27 — 29	27 — 29	28¼	27	..	6 4 2
14,800	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 — 102	100 — 102	..	..	..	4 8 9
17,000	Indo-European Telegraph	25	18 %	18 %	18 %	18 %	53 — 56	51 — 54	..	..	−2	5 18 2
$41,380,480	Mackay Companies Common	$100	2 %	3½%	4 %	4 %	72 — 77	78 — 82	..	..	+5½	4 17 7
$60,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	71 — 76	73 — 76	..	..	+1	5 5 3
894,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	16/6	15/9	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	5 %	6 %	6 %	6 %	¾ — 1	¾ — 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 19 11
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 — 108	106 — 108	107⅜	106½	..	5 11 1
2,725,000	Do. do. Def. Stock	100	5 %	5 %	6 %	6 %	120½ — 122½	123 — 125	126⅜	120½	+2½	4 16 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10¾ — 11¼	10¾ — 11¼	..	..	..	5 6 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10¾ — 11¼	10¾ — 11¼	..	..	..	5 6 8
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅞ — 6⅛	6⅛ — 6	6⅜	5⅞	+⅛	4 3 4
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	3½ %	98 — 100	98 — 100	98¾	98⅜	..	3 10 0
1,716,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 — 102	100 — 102	101⅛	..	..	3 18 5
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	7 %	8 %	8 %	1⅜ — 1½	1 5/8 — 1 7/8 xd	27/6	..	..	5 6 8
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1¼ — 1½	1 5/8 — 1 7/8 xd	23/9	..	..	5 1 1
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	88 — 90	88 — 90	89½	..	..	4 8 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	100 — 102	100 — 102	..	..	..	3 18 5
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 8¼	7⅝ — 8⅛	..	..	+ ⅛	4 14 1
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	100 — 102	100 — 102	..	..	..	4 8 3
3,088	Submarine Cables Trust	Certs.	6 %	6 %	6 %	6 %	127 — 130	127 — 130	129	..	..	4 12 4
190,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6½ — 7⅛	6⅞ — 7⅛	6⅞	..	+⅛	5 12 8
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 10 11
80,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	2½%	2½%	..	1½ — 1¾	1½ — 1¾	25/-	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 — 102	100 — 102	..	..	..	3 18 5
307,380	Western Telegraph, Ltd., Nos. 1 to 207,380.. ..	10	7 %	7 %	7 %	..	13½ — 13⅝	13½ — 13⅝	13⅝	13½	+ ⅛	5 1 10
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 — 103	101 — 103	102⅛	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅞ — 1	⅞ — 1	9/8	9/-	..	Nil
84,568	Do. do. 6 % Cum. 1st Pref.	10	5 %	8 %	6 %	6 %	8⅞ — 9	8¾ — 9	..	..	+ ⅛	6 18 4
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	£2 6	..	7½ — 8¼	8¼ — 9¼	8⅞	..	+1	2 11 4
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 — 103	101 — 103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

220,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 220,008 to 440,007	5	8 %	8 %	9 %	10 %	9 3/16 — 9 5/16	9 3/16 — 9 5/16	9 5/16	9¼	..	5 6 8
*40,007	Do. 6 % Cum. Prefs., 1 to 220,007 ..	5	5⅛%	5⅛%	5⅛%	6 %	6⅛ — 6 7/16	6⅛ — 6⅜	6⅜	6⅛	+⅛	4 14 1
978,280	Do. 4 % Deb. Stock	..	..	..	..	..	90⅜ — 92½	92 — 94	92½	90⅝	+1½	4 6 6
265,110	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —104	102 —104	103⅜	..	..	4 16 2
880,000	Babcock & Wilcox, 1 to 880,000..	1	20 %	20 %	20 %	20 %	4⅛ — 4⅜	4 7/16 — 4 5/8	87/6	82/9	+ 3/8	4 8 7
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 3/16 — 1 5/16	1⅛ — 1⅜	..	..	+ 1/16	4 0 0
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	1¼ — 1⅜	1 — 1⅛	10/-	..	..	20 0 0
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	2⅛ — 2⅜	2⅛ — 2⅜	£0/-	41/3	— ¼	12 8 10
40,100	Do. do. "A" 6 % Cum. Pref. ..	5	6 %	6 %	6 %	6 %	3¾ — 4	3¾ — 4	..	..	..	7 10 0
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3¾ — 4⅛	3¾ — 4⅛	65/-	..	..	4 8 11
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	..	5½%	5½%	5½%	95 — 100	95 — 100	£8	..	..	5 10 0
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	8 %	8 %	143 —147	140 —144 xd	146	..	..	5 11 1
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	122 —126	122 —126	125	..	..	4 15 8
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	107 —110	108⅜ -111⅛	110½	108½	+1½	4 9 8
288,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..	4 8 6
230,000	Do. 4½ % Vancouver Power Debs., 1 to 2,300	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
188,801	British Electric Traction	10	3 %	Nil	Nil	..	⅛ — ¼	⅛ — ¼	12/-	10/-	..	Nil
161,457	Do. do. 8 % Cum. Pref.	10	6 %	6 %	8 %	..	2⅛ — 2½	2⅛ — 2½	£8/9	58/9	..	9 4 7
1,478,628	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	84 — 88	84 — 88	86½	85½	..	5 13 8
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	66 — 71	66 — 71	68½	..	..	6 6 9
100,000	British Insulated and Helsby Cables	5	8 %	10 %	10 %	10 %	6¾ — 7½	6¾ — 7½	⅞	..	..	6 13 4
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6¼ — 6½	6¼ — 6⅝	..	..	+ ⅛	4 10 1
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	105 —108	105 —105	..	..	..	4 9 4
304,941	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	91 — 96	91 — 96	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	⅛ — 3/16	3/16 — 1/4	..	..	..	Nil
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	38 — 43	38 — 43	40⅜	40½	..	9 6 0
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	3/16 — 1/4	3/16 — 1/4	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	2½%	Nil	Nil	Nil	0 — ¼	0 — ¼	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	6 %	Nil	Nil	Nil	0 — ¼	0 — ¼	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	40 — 50	40 — 50	..	..	..	9 0 0
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	29 — 33	29 — 33	..	..	..	13 12 8
197,610	Calcutta Trams, 1 to 197,610	5	8 %	8 %	6 %	..	4 — 4½	4 — 4½	88/-	81/10½	..	6 13 4
45,804	Do. 5 % Cum. Pref., Nos. 1 to 39,800..	5	5 %	5 %	5 %	5 %	4⅞ — 5⅛	4⅞ — 5⅛	5	..	— ⅛	4 15 8
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	99—102	99 —102	..	..	..	4 8 9
95,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	..	9¼ — 10⅛	9⅜ — 10⅛	10⅛	9⅜	..	7 2 10
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105 —107	105 —107	..	..	..	4 4
491,222	Cape E Trams., 1 to 491,222	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	6 %	8 %	12 %	..	1¼ — 1⅜	1⅛ — 1⅜	26/8	25/6	+ 1/16	6 8 0
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	102 —106	102 —106	103½	103	..	4 4 11
1,898,610	Central London Railway, Ord. Stock	Stock	4 %	4 %	3 %	3½%	65 — 67	69 — 71	70	65½	+ 4	4 11 7
568,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	85 — 87	86½	..	+ 2	4 12 0
568,195	Do. do. Def. do.	Stock	4 %	4 %	2 %	2½%	50 — 52	53 — 55	53⅝	51½	+ 3	4 1 10
1,480,000	City and South London Railway	Stock	1¾%	2½%	2½%	1¾%	30¾ — 31½	30¾ — 31½	31½	31	..	4 15 3
85,000	Crompton & Co., Nos. 1 to 85,000	5	3½%	5 %	5 %	5 %	1 — 1½	1 — 1½	..	..	..	9 7 6
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	..	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..	5 2 0

* Unless otherwise stated, all shares are fully paid † A period of nine months. ‡ From Manchester Share List

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(Continued.)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(Continued)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	Closing Quotations Apr. 27th.	Closing Quotations May 4th.	Business done week ended May 4th, 1909. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	8 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	1⅞ — 1¹⁵/₁₆	1⅞ — 1¹⁵/₁₆	..	..	..	4 16 0
276,880	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½ %	4½ %	..	¼ — ⅜	¼ — ⅜	..	..	..	20 0 0
17,189	Do. "A" shares, 01—017,189	5	4½ %	4½ %	..	1½ — 2¼	1½ — 2¼	..	..	..	8 6 9
317,875	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	75 — 78	75 — 78	..	..	..	5 2 7
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	..	84 — 87	84 — 87	..	..	..	5 12 4
112,100	Electric Construction, 1 to 112,100	1	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	1	7 %	7 %	7 %	1 — 1⅛	1 — 1⅛	..	..	..	11 4 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	6 9 0
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	84 — 88	84 — 88	..	..	..	4 10 11
75,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 75,000	10	4 %	4 %	Nil	⅜ — ½	⅜ — ½	..	..	+ ⅛	8 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	..	10¼ — 10½	10¼ — 10½	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	102 —103	102 —103½	..	..	..	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15%	15%	15 %	11½ — 12½	11½ — 12½	12 1/16	11 7/8	..	6 0 0
40,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	5 — 5⅛	4¾ — 5	..	..	— ⅛	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	106 —108	106 —108	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	10 %	..	14¾ — 15½	14¾ — 15½	14 5/8	..	..	6 5 0
57,500	†Liverpool Overhead Railway, Ord.	10	Nil	Nil	Nil	⅞ — 1	⅞ — 1	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 — 6	5 — 6	..	..	..	8 6 8
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	8 %	Nil	2 — 3	2 — 3	..	..	..	4 8 11
999,980	Do. do. 60,008 to 100,000	10	8 %	8 %	Nil	3¾ — 4	3¾ — 4	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	3 — 4	3 — 4	..	..	..	9 7 6
1,261,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	70 — 75	70 — 75	73	72½	..	5 6 8
5,782,062	Metropolitan Consolidated	100	2½%	1 ¼%	¼%	35 — 36	36½ — 37½	37½	35½	+1½	1 6 9
2,640,914	Do. Surplus Lands	100	2½%	2½%	2½%	69 — 71	69 — 71	..	..	..	3 17 6
3,385,000	Do. District	100	Nil	Nil	Nil	14½ — 14¾	15 — 15½	15 7/8	14⅞	+ ⅜	Nil
391,397	Metropolitan Electric Trams., Ord.	1	..	..	4½%	⅜ — ½	⅜ — ½	..	..	..	..
814,016	Do. do. Defd.	1	Nil	Nil	Nil	⅜ — ½	⅜ — ½	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	..	5 19 5
600,000	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	96 — 97	96½ — 97½	96⅞	96⅜	+ ⅜	4 12 4
£6,000,000	Mexico Trams Co., Common Stock	..	..	..	..	142½—144½	147 —149	149	144	+4½	..
£9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	5 %	94½ — 95½	96 — 97	96⅛	95¼	+1½	5 3 1
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	⅛ — ¼	⅛ — ¼	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	⅛ — ¼	⅛ — ¼	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	88 — 91	89 — 91	..	..	..	4 18 11
37,850	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	15	82 — 84	82 — 84	..	..	5 14 10
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	100 —102	101 —103	102	..	+ 1	3 17 8
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	103 —104	101½—102½ xd	103⅜	101½	..	..
2,800,000	Do. do. 4½% Bonds	..	..	..	4½%	85 — 87	86 — 88	..	..	+1	5 2 3
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	34 — 36	34 — 36	..	..	..	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	1	Nil	Nil	10 %	Nil	⅛ — ¼	12/6	..	..	10 0 0
66,666	Do. 6 % C.P., 80,001 to 80,000 & 126,001 to 141,666	5	Nil	..	6 %	2⅞ — 3⅛	2⅞ — 3⅛	66/10½	61/3	..	7 14 10
246,404	Do. 4 % 1st Mort. Deb. Stock		4 %	4 %	4 %	68 — 72	78 — 82	..	..	+10	4 17 7

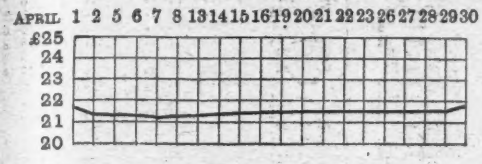
ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000		5½%	5½%	5½%	5½%	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	5 10 6
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	95 — 98	98 — 98	..	..	—2	4 18 9
80,275	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10%	10 %	10 %	8¾ — 9	8¾ — 9	9⅜	..	..	5 11 1
9,725	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8 — 8½	8 — 8½	..	..	..	4 2 4
826,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4½%	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	5 17 8
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4¼ — 4⅜	4¼ — 4⅜	90/-	87/6	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Pref.	5	4½%	4½%	4½%	3¾ — 4⅛	3¾ — 4⅛	..	..	..	5 5 11
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	96 — 98	98 —101	99	98½	+2½	3 19 3
49,436	Chelsea Electricity Supply, Ord.	5	6 %	4½%	4½%	3⅝ — 4⅛	3⅝ — 4⅛	80/-	..	..	5 9 1
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
70,595	City of London Elec. Lighting, Ord. 40,001—110,596	10	6 %	6 %	6 %	10⅜ — 10⅞	10⅜ — 10⅞	10 1/16	10 1/16	..	5 11 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	11½ — 12½	11½ — 12½	..	..	..	4 16 0
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	131 —133	131 —133	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
50,000	County of Durham Electrical Power, Ord.	5	4 %	4 %	2 %	2⅜ — 3⅛	2⅜ — 3⅛	60/-	..	..	3 6 8
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	3¼ — 3½	3¼ — 3½	70/-	..	..	6 18 4
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	96 — 98	96 — 98	..	..	..	5 2 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..	5 14 3
80,997	Do. do. 6 % Pref., 40,001—80,000	10	6 %	6 %	6 %	10⅜ — 11⅛	10⅜ — 11⅛	..	..	..	5 6 8
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	101 —104	99 —102 xd	..	..	..	4 6 7
80,000	Edmundson's Electric Corporation, Ord. Shares	5	4 %	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	3 %	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	59 — 62	59 — 62	..	..	..	7 0 8
$3,150,000	Electrical Dev.Co.of Ontario, 5% 1stMtg.Gold Bnds.	$500	..	..	..	5 %	88 — 90	88 — 90	88	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4¾ — 5	4¾ — 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
15,000	Hove, 1 to 15,000	5	9 %	9 %	8½%	8½%	7⅞ — 7⅞	7⅞ — 7⅞	..	..	..	5 9 8
$2,400,000	Kaministiquia Power Co., 5 % Gold Bnds.	..	..	..	..	5 %	99 —101	99 —101	100	99½	..	4 19 0
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	10 %	8 %	7⅞ — 7⅞	7⅞ — 7⅞	7½	..	..	6 1 8
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 96	93 — 96	..	..	..	4 0 0
111,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	4 %	2½%	3 %	1⅞ — 2⅛	1⅞ — 2⅛	41/10½	..	..	4 16 0
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..	5 11 8
274,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4½%	4½%	4 %	92 — 96	92 — 96	..	..	..	4 3 4
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	8 %	6½%	5 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	4 17 7
75,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	97/6	..	..	4 5 9
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	106 —109	107 —110	..	..	+1	4 1 10
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	85 — 88	85 — 88	..	..	..	3 19 7
£6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	..	5 %	5 %	5 %	87½ — 88½	88½ — 89½	89½	88½	+1	5 11 9
13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	77 — 79	76 — 78	77½	..	—1	4 9 9
£1,500,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	110 —112	109 —111	112	108½	—1	6 6 2
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	5 %	91½ — 92½	92	93	93½	+ ⅛	5 7 6
260,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	98	..	..	4 11 10
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	2½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	8 12 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	4⅛ — 5⅛	4⅛ — 5⅛	..	..	..	4 16 8
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	99 —101	99 — 101	..	..	..	..
10,868	Notting Hill Electric Lighting	10	7½%	7½%	7½%	7 %	11 — 12	11 — 12	..	..	..	5 16 8
20,000	Oxford, 1 to 96 and 407 to 20,319	5	7 %	7 %	7 %	..	6 — 6⅛	6 — 6⅛	..	..	..	5 7 8
60,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 1 8
119,694	River Plate Electy. Co. Ord. Nos. 1 to 120,597	1	..	2½%	6 %	8	1⅛ — 1⅜	1⅛ — 1⅜	20/6	25/6	..	5 16 4
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	5 6 8
194,684	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	102 —106	102 —106	103⅜	..	..	4 14 4
40,000	St. James' and Pall Mall Electric Light, Ord.	5	12½%	10 %	10 %	9 — 9⅛	9 — 9⅛	9 1/16	..	..	5 5 3
80,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 — 7⅛	7 — 7⅛	..	..	..	4 18 4
150,000	Do. do. 5½ % Deb. Stock Red.	100	5 %	5½%	5½%	86 — 90	86 — 90	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	Nil	Nil	⅜ — ½	⅜ — ½	15/-	..	— 1/16	Nil
65,000	South London Electric Supply, Ord.	4	4 %	3 %	4 %	2⅜ — 2½	2⅜ — 2½	103	..	..	6 9 0
90,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	1 — 1 1/16	1 — 1 1/16	..	..	+ 1/16	4 8 11
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	1⅝ — 1¾	1⅝ — 1¾	26/-	109½	..	5 9 10
220,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 0 0
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	2 — 2⅛	2 — 2⅛	43/9	..	..	20 0 0
60,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	2 — 2⅛	2 — 2⅛	..	..	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	80 — 84	80 — 84	..	..	+1	5 7 2
800,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	1 — 1⅛	1 — 1⅛	15/11½	15/-	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	12 %	10 %	9 — 9⅛	9 — 9⅛	9¼	9⅛	— ⅛	5 2 7
81,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1906)	5	5 %	4½%	4½%	5 — 5⅛	5 — 5⅛	5⅛	..	..	4 0 0

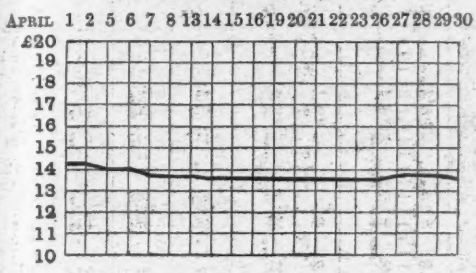
* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. Interim Dividend.

METAL MARKET.—Fluctuations in April.

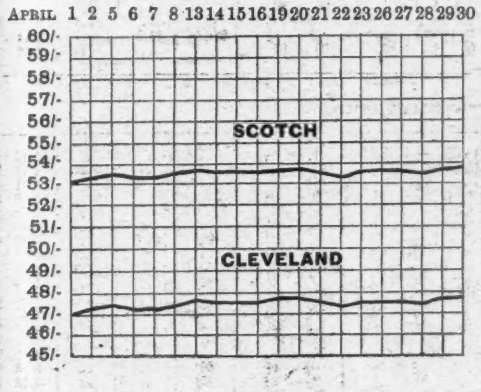
SPELTER (G.O.B's.).



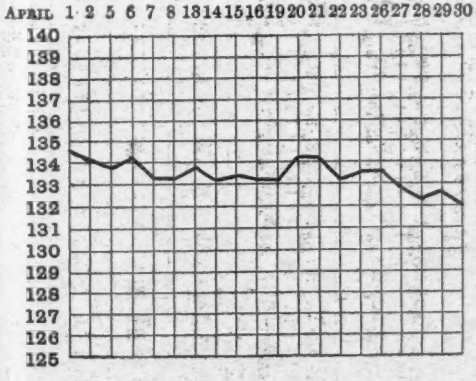
LEAD (ENGLISH).



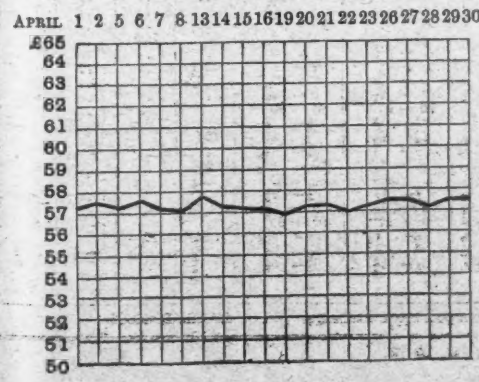
IRON.



TIN.



COPPER (G.M.B's.).



TESTS ON A RECENT SUBMARINE TELEPHONE CABLE.

Herr F. Breisig, of the Prussian Telegraph Department, gives some interesting particulars of telephone cables arranged with a continuous winding of soft iron wire around the copper core, for the purpose of reducing the attenuation by increasing the distributed inductance.

The amount of iron employed has been gradually increased, and the latest cables have several layers of fine wire wound on.

The cable described is the second German-Danish submarine telephone cable between Fehmarn and Lolland, which is 12 miles long, and was laid in October, 1907. It was supplied by Messrs. Felten & Guilleaume-Lahmeyer, and is paper-insulated, with air spaces.

Fig. 1 shows a section of the submarine part, and fig. 2 a section of the 2-km. length of landing cable. There are four cores (two double lines), each consisting of a 2·15-mm. diam. copper wire surrounded by three flat copper strips of 2·4 × ·5 mm. section. Over these are wound three layers of soft annealed iron wire, ·2 mm. diam., closely packed so as to give at least 102 wires per inch in each layer. Over this comes a loose paper cord winding, and then a close paper covering up to a diameter of 7·7 mm. The four cores are twisted together with a diagonal distance of 10·5 mm., and the whole is then insulated with paper up to a diameter of 20 mm. Two continuous lead sheaths, each 1·4 mm. thick, and containing

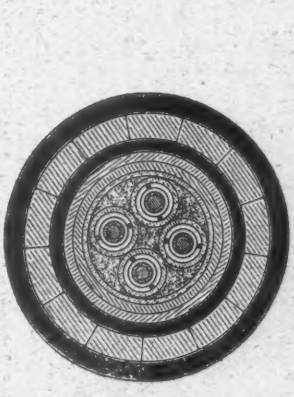


Fig. 1.

Fig. 2.

3 per cent. of tin, are then pressed on without joints. A double layer of paper impregnated with asphalt and a layer of impregnated jute follow, and the whole is armoured with 13 segmental galvanised iron wires, of a section of $\frac{8 + 6{\cdot}4}{2} \times 4$ sq. mm. each, and a final coating of impregnated jute completes the cable.

In the case of the landing cable, a second armouring is added (as shown in fig. 2), consisting of 27 segmental iron wires, 6 mm. deep. The outer diameter of the submarine cable is about 44 mm. (1¾ in.), and of the landing cable about 60 mm. (2⅜ in.), the weights per yard being about 14 lb. and 28½ lb. respectively.

In order to avoid excessive damage in case of puncture of the lead coating, portions of the cable 1 metre long, at intervals of 150 metres, are impregnated, so as to stop up all the air passages and prevent moisture finding its way through.

The electrical data of the cable, measured with direct current, are as follows:—Resistance per mile of double line at 15° C. = 7·7 ohms; capacity of a loop composed of two diagonally situated cores, ·07₀ mfd. per mile. The insulation resistance of each of the cores was over 900 megohms per mile.

Measurements with alternating current of the open-circuit impedance u_1, and the short-circuit impedance u_2, enable the damping constants of the cable to be obtained, for—

$$\alpha = j\delta + \beta = \frac{1}{2s} \log \frac{1 + \sqrt{u_2/u_1}}{1 - \sqrt{u_2/u_1}},$$

where α is the constant determining the length of the waves, β is the constant determining the damping of the waves, and s is the length of the cable.

The values obtained for the specific damping β at various frequencies were as follows:—

$w = 2\pi f$.	β for one pair of cores.	β for other pair of cores.
5,000	·0067	·0067
6,000	·0072	·0072
7,000	·0077	·0079

The capacity with alternating current was found to be almost independent of frequency, and had the value of ·066 mfd. per mile, which is noticeably less than the static measurement.

The self-induction varied slightly with the frequency, and lay between ·0158 and ·0156 henry per mile of double coil.

For the sake of comparison with other cables of the same type, the author considers the best criterion to be the product of the space occupied by the cable per pair of cores by the damping constant β. The smaller this product is, the better may the cables be considered to be. Table I gives particulars of six recent cables:—

TABLE I.

No.	Year.	Cable.	Space for double core in sq. mm.	β	Product.	Insulation.
1	1902	Helsingör-Helsingborg	154	0·0194	2·98	Gutta-percha
2	1902	Fehmarn-Lolland	403	0·0105	4·25	Impreg. paper
3	1903	Greetsiel-Borkum	142	0·0133	1·89	Air space and paper
4	1903	Cuxhaven-Heligoland	315	0·0064	2·00	Air space and paper
5	1907	Korsör-Nyborg	184	0·0120	2·21	Gutta-percha
6	1907	Fehmarn-Lolland	157	0·0069	1·08	Air space and paper

The improvement effected in the more recent cases is principally due to an increase in the amount of iron inserted, and this does not involve much additional expense.—*E.T.Z.*

GERMANY'S EXPORTS OF ELECTRICAL GOODS DURING 1908.

The following statement, showing the quantity of electrical goods of various kinds exported from Germany during the year 1908, is taken from the recently issued official statistics; the figures for the corresponding period of 1907 have been given for purposes of comparison, increases and decreases being shown:—

	In double centners (220·4 lb.).		
	1907.	1908.	Increase or decrease.
Dynamos, Motors, Converters, Transformers and Choking Coils, up to 5 Double Centners weight.—			
To Austria-Hungary ...	8,200	7,800	— 400
„ Great Britain	2,700	3,000	+ 300
„ Belgium	2,900	3,600	+ 700
„ Italy	9,900	12,300	+ 2,400
„ Netherlands	2,600	2,400	— 200
„ Russia in Europe ...	3,800	3,000	— 800
„ Spain	2,500	2,300	— 200
„ Other countries	17,700	17,500	— 200
Total	50,300	51,900	+ 1,600
Ditto, over 5 Double Centners in weight.—			
To France	7,000	15,000	+ 8,000
„ Switzerland	7,600	2,600	— 5,000
„ Netherlands	7,000	8,600	+ 1,600
„ Belgium	17,400	22,500	+ 5,100
„ Great Britain	19,900	19,000	— 900
„ Austria-Hungary ...	9,000	10,600	+ 1,600
„ Italy	24,000	42,000	+ 18,000
„ Russia in Europe ...	8,300	10,500	+ 2,200
„ Norway	9,300	5,800	— 3,500
„ Spain	13,500	16,700	+ 3,200
„ Argentina	8,700	10,500	+ 1,800
„ Japan	4,100	8,900	+ 4,800
„ British S. Africa ...	1,300	8,300	+ 7,000
„ Other countries	35,900	44,000	+ 8,100
Total	173,000	225,000	+ 52,000
Rotors and Commutators.—			
To Great Britain	4,900	3,900	— 1,000
„ Austria-Hungary ...	3,300	3,300	—
„ Italy	3,600	4,800	+ 1,200
„ Russia in Europe ...	2,400	3,700	+ 1,300
„ Other countries	10,800	13,300	+ 2,500
Total	25,000	29,000	+ 4,000
Accumulators and Plates, without horn or rubber, &c.—			
To Denmark	6,000	7,400	+ 1,400
„ Netherlands	3,600	2,000	— 1,600
„ Sweden	7,400	11,100	+ 3,700
„ Argentina	6,700	5,500	— 1,200
„ Other countries	20,300	15,000	— 5,300
Total	44,000	41,000	— 3,000

	In double centners (220·4 lb.).		
	1907.	1908.	Increase or decrease.
Cable.—			
To Netherlands	21,500	27,600	+ 6,100
„ Belgium	27,600	42,000	+ 14,400
„ Great Britain	36,300	24,000	— 12,300
„ Denmark	15,000	26,000	+ 11,000
„ Sweden	37,000	34,400	— 2,600
„ Spain	14,000	5,500	— 8,500
„ Argentina	32,400	28,200	— 4,200
„ Japan	18,200	11,400	— 6,800
„ Uruguay	17,000	4,100	— 12,900
„ Italy	9,600	11,100	+ 1,500
„ Norway	6,200	8,900	+ 2,700
„ Roumania	5,600	6,900	+ 1,300
„ Finland	700	9,200	+ 8,500
„ Other countries	81,900	57,700	— 24,200
Total	323,000	297,000	— 26,000
Arc Lamps.—			
To Belgium	650	600	— 50
„ Russia in Europe ...	600	790	+ 190
„ Great Britain	900	990	+ 90
„ Argentina	560	530	— 30
„ Austria-Hungary ...	410	640	+ 230
„ U.S. America	200	590	+ 390
„ Other countries	3,480	3,560	+ 80
Total	6,800	7,700	+ 900
Incandescent Lamps.—			
To Austria-Hungary ...	450	700	+ 250
„ Italy	450	680	+ 230
„ Great Britain	1,500	3,100	+ 1,600
„ France	680	700	+ 20
„ Russia in Europe ...	780	1,000	+ 220
„ Other countries	3,140	3,820	+ 680
Total	7,000	10,000	+ 3,000
Telegraph and Telephone Material.—			
To France	770	960	+ 190
„ Great Britain	1,960	2,640	+ 680
„ Italy	1,020	1,570	+ 550
„ Austria-Hungary ...	780	630	— 150
„ Switzerland	880	780	— 100
„ Belgium	1,460	1,370	— 90
„ Netherlands	1,190	640	— 550
„ Russia in Europe ...	1,910	1,150	— 760
„ Denmark	900	1,120	+ 220
„ Brazil	370	780	+ 410
„ Other countries	4,060	3,460	— 600
Total	15,300	15,100	— 200
Electrical Apparatus for Lighting, Power, &c.—			
To Belgium	3,350	6,430	+ 3,080
„ Great Britain	5,140	5,870	+ 730
„ Netherlands	2,010	4,140	+ 2,130
„ Spain	3,140	3,810	+ 670
„ Switzerland	2,520	2,770	+ 250
„ Italy	6,240	7,530	+ 1,290
„ Austria-Hungary ...	4,650	6,530	+ 1,880
„ Russia in Europe ...	4,810	6,290	+ 1,480
„ Sweden	2,950	4,910	+ 1,960
„ Argentina	4,200	5,310	+ 1,110
„ Chile	2,530	3,210	+ 680
„ Japan	760	2,320	+ 1,560
„ British S. Africa ...	460	2,830	+ 2,370
„ Denmark	1,700	2,800	+ 1,100
„ Uruguay	2,000	1,500	— 500
„ Other countries	9,340	12,650	+ 3,310
Total	55,800	78,900	+ 23,100
Electrical Measuring and Recording Instruments.—			
To Great Britain	560	510	— 50
„ Italy	1,260	1,470	+ 210
„ Austria-Hungary ...	1,750	1,890	+ 140
„ Switzerland	740	510	— 230
„ Denmark	550	720	+ 170
„ Sweden	570	710	+ 140
„ Russia in Europe ...	980	1,240	+ 260
„ Spain	590	530	— 60
„ Other countries	2,700	3,070	+ 370
Total	9,700	10,650	+ 950
Carbons, Brushes, &c.			
To France	2,980	2,360	— 620
„ Switzerland	2,780	1,570	— 1,210
„ Austria-Hungary ...	2,720	2,940	+ 220
„ U.S. America	8,180	5,530	— 2,650
„ Great Britain	11,000	14,120	+ 3,120
„ Italy	4,590	6,650	+ 2,060
„ Other countries	14,120	16,630	+ 2,510
Total	46,370	49,800	+ 3,430

THE RATING AND COST OF STEAM ELECTRIC GENERATING STATIONS.*

By H. M. HOBART, M.Inst.C.E.

The rating inscribed on the name-plate of an electricity generating set is often of comparatively little use as an indication of its capacity, since, although machines are usually built and sold to some sort of a specification, there is no widely adopted standard of temperature rise and overload. Furthermore, a great deal of electric plant does not, in service, remotely conform to the specified conditions. In still other cases, the purchase is effected on the basis of a rating which is subsequently inscribed on the name-plate of the machinery which the manufacturers elect to deliver. Thus it has come about that little or no useful knowledge is imparted when it is stated that the capital cost of a certain electricity supply station is, say, £20 per rated kilowatt of plant installed. Usually the statement is even less definite. We are told that the capital cost is £20 per kilowatt, but we are often not told whether this is (*a*) "per *rated* kilowatt of *plant installed*," or (*b*) "per rated kilowatt of plant installed, *exclusive* of the proportion considered to be spare plant," or (*c*) per kilowatt of *peak* load from the station," or (*d*) "per kilowatt of *average* load from the station."

An electricity supply station should preferably be rated in terms of the annual output, in kelvins (*i.e.*, in Board of Trade units), for which it has been designed, and this is the basis at which I arrive in the course of this paper.

At the outset of the investigation, however, it is essential to formulate a reference basis for the rating of steam-electric generating sets.

The sets shall be capable of dealing with 25 per cent. overload for one hour, and with 50 per cent. overload for five minutes without detriment to any part. When continuously operated at the rated output, no accessible part of the electric generator shall sustain a temperature rise, as thermometrically determined, of more than 40° C. above the temperature of the engine room in the neighbourhood of the generating set. As modern practice for large electricity supply stations is now so uniformly toward the exclusive use of polyphase generating sets, the above brief specification contains no reference to commutation.

It is not necessary to encumber this investigation with a more detailed specification, although there are, of course, many features, such as the steam consumption of the set, the pressure regulation, the insulation, the uniformity of angular rotation and other features of importance, which require to be carefully specified. The brief statement of the overload and heating requirements, however, gives definite knowledge of the basis of the rating, and it is in accordance with this basis, and assuming good design and workmanship throughout the entire station, that I have entered in Table I representative values for the cost of complete electricity supply stations :—

TABLE I.

Aggregate rated capacity of generating sets installed.	Cost of complete station in £ per rated KW. of all generating sets installed.	Total cost of electricity supply station.
48,000 KW.	£14	£671,000
24,000 KW.	£15	£360,000
12,000 KW.	£16	£192,000
6,000 KW.	£18	£108,000
3,000 KW.	£21	£63,000
1,500 KW.	£25	£37,500
750 KW.	£30	£22,500

For a load factor of 1·00, a considerably greater percentage of all the generating sets installed must be regarded as spare plant, than for a smaller load factor. For an undertaking with a very small load factor, there is opportunity for generating sets to be overhauled and repaired during the times of prolonged light load. Such opportunities occur less often the higher the load factor, and with unity load factor, since there will be no such opportunities, a relatively large percentage of the total number of generating sets in the station must be regarded as spare plant. Furthermore, for *any* load factor, the percentage of spare plant must be greater the smaller the undertaking. These considerations have been taken into account in the preparation of Table II, in which are given values for the percentage of the aggregate installed capacity which should be regarded as spare plant :—

TABLE II.

Aggregate rated capacity of generating sets installed. KW.	Percentage to be regarded as spare plant for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
48,000	24	22	20	18	16	14	12
24,000	25	24	22	20	18	16	14
12,000	26	25	24	22	20	18	16
6,000	28	26	25	24	22	20	18
3,000	30	28	26	25	24	22	20
1,500	33	30	28	26	25	24	22
750	37	33	30	28	26	25	24

Thus, to illustrate the meaning : let us take an electricity supply station in which is installed an aggregate of 6,000 KW. of generating sets. If the load factor is 0·40, then 24 per cent. of the installed capacity may be regarded as spare plant, leaving 0·76 × 6,000 = 4,560 KW. always available for service. Usually a larger proportion would be available, but the capacity of the station should be estimated on the basis of always having 4,560 KW. available for immediate service.

TABLE III.

Aggregate rated capacity of generating sets installed. KW.	Capacity available for immediate service for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
48,000	36,500	37,400	38,400	39,300	40,300	41,300	42,200
24,000	18,000	18,200	18,700	19,200	19,700	20,400	20,600
12,000	8,880	9,000	9,120	9,350	9,600	9,850	10,100
6,000	4,320	4,440	4,560	4,560	4,680	4,800	4,920
3,000	2,100	2,160	2,220	2,250	2,280	2,340	2,400
1,500	1,000	1,050	1,080	1,110	1,125	1,140	1,170
750	472	502	525	540	555	562	570

The values in Table III thus represent the maximum load for which the station is designed. Of course there is the overload capacity of the sets, but this should be regarded more in the light of a feature of a single generating set whereby, when carrying an *average* load equal to its rated load, it shall not be sensitive to considerable fluctuations of load entailing more or less sustained overloads. Also in a large station at a time when the load is coming on, if, say, three sets are carrying the load, it is not in the interests of efficiency to run up a fourth set until the load has so increased that each one of the three sets is somewhat overloaded.

For these and analogous purposes, generating sets must be capable of overloads, but the station should be so designed that the generating sets, *exclusive of spares*, shall be able to handle the maximum load on the station, without exceeding their aggregate rated capacity.

TABLE IV.

Aggregate rated capacity of generating sets installed. KW.	Annual output of electricity in millions of kelvins for following load factors—						
	1·00	0·80	0·60	0·40	0·30	0·20	0·10
48,000	319	262	202	138	106	72·4	36·9
24,000	158	128	98·5	67·1	51·7	35·7	18·0
12,000	77·6	63·0	48·9	32·7	25·2	17·2	8·85
6,000	37·8	31·1	23·6	16·0	12·3	8·40	4·31
3,000	18·4	15·1	11·6	7·87	6·00	4·10	2·10
1,500	8·75	7·35	5·66	3·88	2·96	2·00	1·02
750	4·13	3·52	2·76	1·89	1·46	0·99	0·498

Thus in the case of a station with an aggregate installed capacity of 6,000 KW., and with a load factor of 0·40, we see from Table III, that, after deducting the spares, we have an

* This article was in our hands before Mr. Addenbrooke's lectures on a kindred subject were delivered.—EDS. E.R.

available rated capacity of 4,560 KW. The maximum output of the station may thus be 4,560 KW., and since the load factor is 0·40, the *average* output is 4,560 × 0·40 = 1,825 KW.

Consequently since there are 8,750 hours in one year, the quantity of electricity which the station is designed to deliver per annum is 1,825 × 8,750 = 16,000,000 kelvins, or 16·0 megakelvins. In the same way the other values in Table IV (page 781) have been derived.

Again, using for illustration the station with 6,000 KW. aggregate rated capacity of installed plant and with a load factor of 0·40, we can deduce from the data in Table IV that the rated capacity of all sets installed per megakelvin of annual output from the station is $\frac{6,000}{16·0}$ = 375 KW. This value and corresponding values for all the other cases have been brought together in Table V :—

TABLE V.

Aggregate rated capacity of generating sets installed. KW.	Rated capacity in KW. of all generating sets installed per million kelvins delivered from the generating station per annum for the following load factors— 1·00	0·80	0·60	0·40	0·30	0·20	0·10
48,000	151	183	238	348	453	665	1,300
24,000	152	188	244	357	464	673	1,330
12,000	155	190	246	366	475	696	1,380
6,000	159	193	254	375	488	715	1,390
3,000	163	199	259	382	500	731	1,430
1,500	172	204	264	387	507	750	1,470
750	182	214	272	396	514	758	1,500

From Tables IV and I we may obtain values for the capital cost of electricity supply stations per million kelvins output per annum. Thus the station with 6,000 KW. rated capacity of generating sets costs, as we see from Table I, £108,000, and when supplying at a load factor of 0·40 is suitable for an output of 16·0 megakelvins per annum. The capital cost per megakelvin per annum is thus—

$\frac{108,000}{16·0}$ = £6,750 for an electricity supply station designed for an output of 16·0 megakelvins per annum at a load factor of 0·40. This value and corresponding values for the other cases are entered up in Table VI :—

TABLE VI.

Aggregate rated capacity of generating sets installed. KW.	Capital cost of complete generating station in £ per million kelvins output per annum for following load factors— 1·00	0·80	0·60	0·40	0·30	0·20	0·10
48,000	2,110	2,560	3,330	4,860	6,340	9,290	18,200
24,000	2,280	2,820	3,660	5,360	6,950	10,100	20,000
12,000	2,480	3,050	3,920	5,860	7,600	11,200	21,700
6,000	2,860	3,460	4,560	6,750	8,780	12,850	25,000
3,000	3,420	4,170	5,440	8,000	10,500	15,400	30,000
1,500	4,600	5,100	6,630	9,680	12,700	18,800	36,800
750	5,450	6,400	8,150	11,900	15,400	22,800	45,100

TABLE VII.

Aggregate rated capacity of generating sets installed. KW.	Annual capital expenses in £ per megakelvin for following load factors— 1·00	0·80	0·60	0·40	0·30	0·23	0·10
48,000	211	256	333	456	634	929	1,820
24,000	228	282	366	536	695	1,010	2,000
12,000	248	305	392	586	760	1,120	2,170
6,000	286	346	456	675	878	1,285	2,500
3,000	342	417	544	800	1,050	1,540	3,060
1,500	480	510	663	968	1,270	1,8e0	3,680
750	545	640	815	1,190	1,540	2,280	4,510

The interest on this capital outlay and the annual outlay necessary for overhauling and for repairs and for new plant, as the old requires from time to time to be discarded, may be covered by the term "annual capital expenses." Taking these as aggregating 10 per cent., we obtain the values set forth in Table VII.

From the values in Table VII we obtain Table VIII, which gives the "annual capital expense" in *pence per kelvin of output* :—

TABLE VIII.

Aggregate rated capacity of generating sets installed. KW.	Annual capital expenses in pence per kelvin output, for following load factors— 1·00	0·80	0·60	0·40	0·30	0·20	0·10
48,000	0·051	0·062	0·078	0·117	0·152	0·223	0·437
24,000	0·055	0·068	0·088	0·129	0·167	0·242	0·480
12,000	0·060	0·073	0·094	0·141	0·183	0·269	0·521
6,000	0·069	0·083	0·109	0·162	0·211	0·308	0·600
3,000	0·082	0·100	0·131	0·192	0·252	0·370	0·720
1,500	0·115	0·122	0·159	0·232	0·305	0·451	0·884
750	0·131	0·154	0·195	0·286	0·370	0·547	1·08

(To be continued.)

NOTES ON RADIATORS.

By A. K.

When electrical energy is supplied to any form of electric radiator, the whole of it is given out as heat. This follows from the well-known law of Joule for the heat developed—

Heat developed per second = $C^2 R = C E$.

The efficiency of all radiators, from this point of view, must obviously be 100 per cent., but it is well known that, in the matter of warming a room, radiators differ widely in effectiveness.

It is difficult in the extreme to find anyone with clear ideas as to what is really the practical efficiency of radiators. One manufacturer states in his circular that it must be borne in mind that each of his lamps consumes only 120 to 160 watts "per hour," and will develop as much heat as an ordinary lamp consuming 250 watts "per hour." (When will people learn not to talk about "watts per hour"? They might as well say "radiators per hour.")

Table I.

Lamp.	Volts.	Amperes.	Watts.	Candle-power.
A 1	100	1·86	186	1·24
A 2	100	1·96	196	1·22
A 3	100	1·92	192	1·22
A 4	100	1·76	176	·52
A 5	100	1·87	187	1·13
A 6	100	1·88	188	1·13
B 1	100	2·63	263	2·52
B 2	100	3·2	320	7·83
C 1	100	2·6	260	1·69
C 2	100	2·15	215	·13
C 3	100	1·9	190	·54
C 4	100	1·92	192	1·53
D 1	100	2·36	236	8·94
D 2	100	2·34	234	12·3
D 3	100	2·38	238	12·3
D 4	100	2·55	255	15·75

Although the statement, as given, is nonsense, it is clear that it is intended to have a meaning, and it must be this: that the effectiveness of his radiator in warming a room is equal to that of other radiators which consume more energy.

With a view to obtaining some facts about this matter experiments were undertaken, and the results are given in the accompanying tables.

Four different kinds of lamps were used, and each kind is denoted by a letter. The number following the letter identifies any particular lamp of any manufacture.

The lamps A contained an inert gas, so that the filament was not in a vacuum. The lamps C 3 and C 4 were tinted with rhodamine, the one uniformly, the other in longitudinal stripes. The object of this was to diminish the lamp's usefulness as an illuminating device, on account of the differ-

ence in the prices per unit between electricity for light and electricity for heat.

The first determination made was the actual candle-power of each lamp; this is shown in Table I.

The bulb of a Centigrade thermometer was blackened, and a small funnel of blackened paper was attached to it, so as to collect the radiant heat and direct it on to the bulb. Readings were then taken of the steady temperature attained at different distances from the source of heat, the temperature of the room being observed at the same time. The results obtained are given in Table II.

In Tables II and IV T represents the reading of the thermometer with the blackened bulb, Rm. the temperature of the room, and Dif. the difference between them.

The lamps were then fixed in radiator bodies, and similar observations were made. Table III gives particulars of the radiators.

TABLE II.

Lamp.	A 1			B 1			B 2			C 1			C 2			C 3			C 4			D 1		
Cm. distant.	T	Rm.	Dif.	T	Rm.	Dif.	T	Rm.	Dif.	T	Rm.	Dif.	T	Rm.	Dif.	T	Rm.	Dif.	T	Rm.	Dif.	T	Rm.	Dif.
20	29·8	17	12·8	33	18 3	14 7	35 7	17·1	18·6	35·4	18·5	16·9	30	17	13	30	18·2	11·8	29	16·9	12 1	35	17·5	17·5
40	21·5	17	4·5	24 5	18·4	6·1	25	17	8	26·4	18·5	7·9	21·7	17	4·7	24·5	18	6 5	21·8	16 9	4 9	24·1	17·9	6·2
60	19·7	17·2	2·5	23	18·5	4·5	21·8	17·1	4·7	22 5	18·7	3·8	19·7	17	2·7	22	18	4	19·8	16 9	2·9	21·2	17 9	3·3
80	19	17·3	1 7	22	18·5	3·5	20	17·2	2·8	21·5	18·9	2·6	18·7	17	1·7	20·3	18·2	2·1	18 9	17	1·9	20·3	18	2·3
100	18·3	17 3	1	20·2	18·6	1·6	19·2	17·1	2·1	20·8	19	1·8	18·1	17	1·1	20	18·4	1·6	18 3	17	1·3	20	18	2
120	18·2	17·5	·7	20	18·7	1·3	18 9	17·1	1·8	20·2	17 7	2·5	17·9	17	·9	19·9	18 5	1·4	18·1	17·1	1	19·8	18	1·8
140	18·1	17·7	·4	19·9	18·7	1·2	18 7	17·1	1·6	20·1	18·2	1·9	17·8	17	·8	19 8	18 7	1·1	18	17·1	·9	19 5	18	1·5
160	18	17·8	·2	18·2	17·1	1·1	18·6	17·1	1·5	19·8	18·7	·8	17·7	17	·7	19·8	18·8	1	17·9	17·1	·8	19·3	18	1·3
180	17 9	17·8	·1	18	17	1	...	...	...	19·2	18·5	·7	17·6	17	·6	19·8	18·9	·9	...	...	...	19·2	18	1·2
200	17·8	17 8	0	18·7	18	·7	18·5	17·2	1·3	19·1	18·4	·7	17·5	17	·5	19 6	18·8	·8	17 8	17·1	·7	18 8	18	·8
220	...	...	...	...	...	...	...	...	...	...	...	...	17·5	17	·5	...	...	...	...	...	...	...	...	...
240	...	...	...	18·4	17·3	1·1	...	...	...	...	...	...	...	...	...	...	...	...	17·7	17 1	·6	...	...	...
250	...	...	...	...	...	...	...	...	...	19 7	19	·7	...	...	...	..	...	...	...	...	...	...	...	...
280	...	...	...	...	...	...	18·8	17 8	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
350	...	...	...	...	...	...	18·2	17·8	·4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE IV.

Radiator.	No. 1.			No. 2.			No. 3.			No. 4.			No. 5.		
Cm. distant.	T.	Rm.	Dif.	T	Rm.	Dif.	T	Rm.	Dif.	T	Rm.	Dif.	T	Rm.	Dif.
20	79	18·8	60·2	76·5	17·7	58·8	68·5	16·5	52	75	17·3	57·7	20	16	4
40	50	18·8	31·2	49 5	17·7	31 8	42·7	16·8	25 9	47·5	17·5	30	18·2	16	2·2
60	36	18·9	17·1	36	18	18	31·8	16·8	15	33·5	17·8	15·7	17·4	16·1	1·3
80	30	19	11	29·1	18	11·1	26·5	16·8	9 7	28	17·8	10·2	17	16·1	·9
100	27	19	8	26	18	8	23 2	16·8	6·4	25	17·8	7·2	16·9	16·1	·8
120	25·5	19	6·5	24	18·1	5 9	...	...	...	23·1	17·8	5 3	...	...	...
140	24	19	5	22·9	18	4·9	20·5	16 9	3·6	22	17·8	4·2	16 8	16·1	·7
160	23 3	19	4·3	...	...	...	...	...	...	21·3	17·9	3·4	...	...	...
180	23·8	19	3 8	...	...	...	...	...	...	...	...	...	...	...	...
200	22·2	19	3·2	21	18 1	2·9	19	16·9	2·1	20·2	17·9	2·3	16·7	16·2	·5
220	21·8	19	2·8	...	...	...	...	...	...	...	...	...	...	...	...
240	21·7	19	2·7	...	...	...	...	...	...	...	...	...	...	...	...
260	21·5	19	2 5	...	...	...	...	...	...	...	...	...	...	...	...
300	...	...	...	19·8	18·3	1·5	18	16 9	1·1	19	18	1	16·5	16·3	·2
400	...	...	...	...	...	...	17·5	16·9	·6	18·8	18	·8	...	...	...
440	20	19	1	19	18·5	·5	...	...	...	...	...	...	...	...	...
500	...	...	...	18·7	18·5	·2	17	16 9	·1	18·5	18	·5	...	...	...

TABLE III.

Radiator.	Number of lamps.	Description of lamps.	Volts.	Amperes.	Watts.
No. 1	6	A	210	6 16	1294
„ 2	4	B 1	201	5·4	1085
„ 3	4	C 1	200	4·8	960
„ 4	4	D	200	5	1000
„ 5	non-luminous		200	1·89	378

Radiators 2 and 3 were made up of different lamps in the same body. Radiator 5 had a regulating switch, but was tested at the full heat only.

As has been previously stated, the lamps A contain an inert gas, and do not give much light; the B lamps are bright; all the C lamps are dull; and the D lamps are bright.

From these results, and also from theoretical considerations, it is clear that from the radiator point of view, bright lamps are best. Most of the heat energy is thrown off from them in vibrations of high frequency and short wave-length; some of it is visible to human sight, and appears as light. It is frequently supposed that the energy which appears as light is wasted, but that is not the case. Heat which comes off in visible form, that is to say, as light, does not heat the air in passing through it, but heats objects in its path. A dull lamp, or a non-luminous radiator, heats the air which is in contact with it, and gets rid of its heat mainly by convection, partly by conduction, and only to a slight extent by radiation.

In the case of the A lamps, there is better conduction through the inert gas from the filament to the glass than there is through a vacuum, and consequently the glass is hotter. This makes the A lamp a better and more effective convector, or warmer of the air in a room, but a bright lamp—such as one of the D type—heats objects around it more rapidly, and is in general more comfortable if required in place of an ordinary stove.

In many cases radiator lamps have been installed for the prevention of down-draughts in churches and large halls. The lamps are placed in similar positions to the ordinary illuminating lamps; that is to say, they are hung from the roof. They warm the air about them, and do not allow it to fall in a cold cascade on to the heads of the people below. Dull lamps should be used for this purpose. The first reason for this is that they are more effective. Their duty is to heat the air, not to shine brightly and warm the back of somebody's neck, while allowing the draught to circulate without interference. The second reason is that it is undesirable that they should have sufficient light-giving properties to enable the lighting lamps to be turned out (during the sermon, for example),

and thus to light the building for one penny, instead of fourpence, per unit.

The effect of colouring the lamp on the outside is to decrease its radiating and to increase its convective properties, by absorption of the short-length vibrations. It has been suggested that if the lamp were painted dead-black it would be possible to prevent any light from getting out, and to estimate the true efficiency of the lamp as an illuminator. Perhaps it was thought that the energy which went to the production of light would accumulate in the bulb, and that when the black paint was scraped off a mass of light would shoot out, as the music came out of Baron Munchausen's frozen bugle. It is not by any means universally understood that all the energy supplied to any resistance is dissipated as heat; but even at the risk of being tedious it must be repeated, that it is impossible to get out of a radiator lamp either more heat or less heat than the equivalent of the energy supplied to it.

Frosting the glass of a lamp by sand blasting has no effect on its properties as a radiator. It does not decrease the transparency of the glass. Radiant heat of all wave lengths can come through frosted glass as well as through clear glass, but it is broken up and diffused in its passage. This causes the lamp to present a softened and more pleasing appearance than a bright filament visible through clear unshaded glass. The spherical candle-power of a frosted lamp is the same as that of a clear lamp, other things being equal, but the candle-power in any given direction may be increased or decreased according to circumstances.

A formula is given in that invaluable little publication, Whittaker's "Electrical Engineer's Pocket-book," which enables us to determine the heat dissipated by radiation. The following formula gives the temperature rise :—

$$\text{Watts} = \text{W S} \frac{\theta}{t} \times \cdot 524,$$

where W = lb., S = specific heat of the material, θ = temperature rise in degrees Centigrade, and t = time in hours.

Having given the nature of the radiating surface, represented by a constant k, its area A, and the difference in temperature θ between the radiating surface and the surrounding space, we have—

$$\text{Watts dissipated by radiation} = k \text{ A } \theta.$$

Claims are sometimes made by manufacturers that their particular pattern of radiator body is better than any other pattern. It is important to remember, in this connection, that where the lamps are enclosed, as is usually the case, in a metal structure, more or less in the form of a Dutch oven, provision should be made for getting rid of the heat created immediately around the lamps by radiation and convection, in order that their working temperature may be kept as low as possible. This will have the effect of lengthening the life of the filament considerably, and the very long life of the lamps employed is one of the advantages which has gone far to increase the popularity of the luminous electric radiator. The construction of a radiator body is apparently not a difficult matter, and has attracted many metal workers as offering some scope for decorative skill, and constituting a useful selling line, without requiring any great technical knowledge as a preliminary to successful construction.

There is a very considerable difference between a well-designed and an ill-designed radiator interior. The metal-work behind the lamps, generally of sheet copper, or at least some material with a copper-like surface, should be arranged so as to reflect forward as much of the radiant heat as possible, without reflecting it directly on to the lamps. This is best effected by convex corrugations, either in triangular or semi-circular form behind the lamp, but examples are often seen where a concave or trough-like reflector is provided for each lamp—an arrangement which must result in raising the temperature of the lamp unnecessarily. The temperature of the body generally is kept down by convection currents of air, set up around the lamps, and in the best radiators provision is made to assist these currents by means of double backs, or channels behind the reflectors, by which cool air from the bottom of the radiator may rise, become heated, and then be dispersed into the room from the top of the apparatus. Considerable difference is found in the arrangement of these channels; many of the devices employed are much less efficient than is desirable.

In some circumstances the luminosity of the radiator lamps is found to be a drawback, as the light given off rises straight into the eyes of persons sitting near the radiator and interferes with the comfortable reading of any semi-transparent paper held in front of it. Attempts have been made to overcome this by fixing louvre-like shutters of metal in front of the lamps, and still more recently, by curtains composed of strings of beads. It must be remembered, however, that unless these devices are designed with care, much of the advantage of the stove is lost, from the radiator point of view, on account of the destruction of its radiating properties. In order to increase the convective effect of heater lamps, the method has been tried of surrounding them with metal cases, in cylindrical or other form, through which the air of the room is supposed to rise rapidly by the action of the hot lamp within. Undoubtedly this action takes place, but any increased effect which may be obtained in warming a body of air is distinctly at the expense of the efficiency of the stove as a radiator. It would seem possible that the most economical results could be obtained by combining some form of resistance convector stove with radiant lamps, so that either or both could be used at will according to the work required to be done—the warming up of the air in a room, or the immediate availability of a source of heat for personal comfort or other purposes.

PROCEEDINGS OF INSTITUTIONS.

The Laws of Heat-Transmission in Steam Boilers.

By J. T. Nicolson, D.Sc., M.Inst.C.E.

On January 14th Prof. Nicolson delivered an important lecture before the Junior Institution of Engineers, of which he had been elected an honorary member. In his address he gave the results of experiments which he had carried out at Manchester during the past four years, with a view to ascertaining the facts regarding the transmission of heat from the flue gases to the water in steam boilers.

The subject had been attacked as long ago as 1874 by Prof. Osborne Reynolds, who laid down the principle that the heat transferred is nearly proportional to the speed of flow; in 1897 Mr. T. E. Stanton confirmed the truth of this law for cases in which water only was employed, and in 1899 Prof. John Perry, in his book on the "Steam Engine," remarked that an immense increase in the rate of evaporation ought to be obtainable when a good scrubbing action was established on both sides of the metal. The Geological Survey Department of the United States took up the matter on the strength of Prof. Perry's remarks, and further verified the law.

Introducing the subject of his own tests, the author recalls that the ordinary formula for heat flow across the plate is—

$$Q = k (T - t)/e \text{ B.TH.U. per hour per sq. ft.}$$

where T and t are the temperatures (Fahr.) of the two surfaces, e is the thickness of the plate in inches, and k is the thermal conductivity = 450 for wrought-iron or mild steel. But this formula gives results some 200 times as great as are realised in practice.

The formula of Rankine and Péclet, $Q = (T - t)^2/a$, for the transfer of heat from the gases at temperature T to the water at t, when combined with the foregoing, shows that the temperatures of the two sides of the plate can differ by only 7° or 8° F., most of the drop (about 1,140°) taking place between the hot gases and the plate. The constant a is usually taken as 200.

The author believes that there is an exceedingly thin stationary film of gas on the one side, and of water on the other, which oppose very great resistance to the flow of heat; thus, the use of copper instead of steel, or thin tubes instead of thick, in the hope of obtaining a better heat transmission, is futile. By increasing the speed of the gases, however, to 10, or even 50 times, that which now obtains, the cooled films adhering to the surface of the plate are torn off and whirled into the body of hot gases, while new hot films take their places. The communication of heat from a film to the plate is practically instantaneous, and if the cooled films can thus be rapidly replaced, the rate of transfer of heat from the gases to the plate can be enormously accelerated. An evaporation of 45 lb. per sq. ft. per hour has been secured by the author, by simply increasing the rate of flow of the gases through the flue of a Cornish boiler, beyond the bridge; this was effected by nearly filling up the flue with an internal cylindrical water vessel of boiler plate, leaving only an annular air space 1 in. wide, 40 in. in mean diameter, and 10 ft. long. The heat transmitted through the plates was 34,450 B.TH.U. per sq. ft. per hour, about eight times the rate usually obtained, the speed of the gas current being about

330 ft. per second. This experiment shows that the rate of heat transference is directly proportional to the speed of flow of the gas, and as Rankine and Péclet's formula takes no account of the speed, it obviously breaks down. The power required to drive the exhausting fan amounted to about 4½ per cent. of the whole power available; on the other hand, the output of the boiler was increased to eight times the normal, and there would therefore be a great saving in the cost of boilers, floor space, &c., for equal output.

In 1905 Dr. Nicolson conducted a series of experiments on the flow of heat from warm compressed air to water, both flowing in concentric pipes; these were described in the lecture in detail, and the problem of steady flow of heat under these conditions was mathematically analysed. Other experiments of his own and other investigators were also discussed at length, and a general formula was arrived at for the heat transference from a gas flowing along a flue, as follows—

$$Q = \left[\frac{\phi}{200} + \frac{1}{40}\sqrt{\frac{\phi}{m}}\left(1 + \frac{1}{m}\right)\rho u \right](T - \theta),$$

where—

Q = B.TH.U. transferred per hour per sq. ft. of flue surface;
T = temperature of gas flowing along the flue (° F.);
θ = temperature of metal wall of flue;
$\phi = \frac{1}{2}(T + \theta)$ = mean film temperature;
ρ = density of gas, lb. per cb. ft.;
u = speed of gas, ft. per second;
m = hydraulic mean depth of flue or pipe = a/c;
w = lb. of gas flowing per second;
a = area of flue in sq. in.;
c = perimeter of flue in inches;
$\rho u = w/a$.

This formula was also applied to actual data and shown to give results in good agreement with those obtained in practice, and it was shown how the old Rankine formula gave approximate agreement with results over customary ranges of temperature and at ordinary speeds of flow, the constant a being arbitrarily modified by the users to suit circumstances. As increased draught was ordinarily accompanied not only by higher speeds of flow, but also by a greater rate of combustion of fuel, users of the old formula accounted for the enhanced rate of evaporation per foot of heating surface, on the ground that the gas was at a higher mean temperature; as a matter of fact, the increased rate was due almost entirely to the higher gas speed, and only in a minor degree to the higher temperature. By the exercise of taste in the choice of the constant, the old formula was capable, by good luck rather than by intelligent guidance, of representing the results of boiler trials to a fair degree of approximation. The old formula is, however, essentially erroneous, while the new formula, being a true law of nature, holds both under ordinary conditions and under extreme circumstances.

As regarded the bearing of his results upon boiler practice, the author stated that a reduction of the heating surface to even one-tenth of that now usual could be made, without increasing the chimney temperatures or lowering the efficiency. Or if the surface were unchanged, but the cross-sectional area through the flues reduced, a much lower chimney temperature and higher efficiency could be secured. Draughts of 10 or 20 in. of water gauge, induced by fans, should always be employed for economical working. If the boiler were designed on the economiser principle, with strict attention to counter-current methods of flow, a chimney temperature of 100 to 150° F. could be attained, corresponding to a boiler efficiency of over 95 per cent.; thus the margin of additional evaporation more than covered the power required for the fan, and therefore higher economies were attainable, with smaller boilers, less floor space and lower first costs than at present. Combustion could be carried on in a lined chamber, ensuring perfect smokelessness. The author believed that the proposed new method of working was capable of effecting radical improvement in steam boiler practice, without which the steam engine could not retain its pre-eminence in the economical production of power.

The Electrical System of the L.C.C. Tramways.

(Discussion on Mr. J. H. Rider's paper on the above, before the INSTITUTION OF ELECTRICAL ENGINEERS, *London, March 25th, April 1st and 22nd.*

THIS discussion was opened by MR. F. BAILEY (City of London Co.), who, on the question of suitability of plant, considered that the Musgrave engines had justified their adoption, and that probably they would be running long after two or three types of turbines had passed away. It seemed a pity that so much soda was used in the feed water, judging by the amount of water blown off; this excessive blowing off would cost about £529 in coal per annum. On the matter of river water for condensing, the trouble experienced at Bankside had led to the adoption of rotary strainers, as it was found that 1-in. or even 2-in. mesh grids were always clogged by the matter in suspension in the river. He did not consider that the system was too complicated in the case of a large plant. At Greenwich the head was 30 ft., and this led to a leakage of about 15 per cent., but at Bankside, with only 10 ft. head, they had no leakage.

MR. B. M. JENKIN said that the author might consider whether it was not worth while to prevent the great shock experienced on the windings of the motor-generators when switching-in. The oscillograph did not indicate this excessive pressure, which was confirmed by his own experience, but it certainly existed, and to, perhaps, twice normal pressure. The author used choke coils in series with his machines, but he (the speaker) thought Ferranti charging apparatus better, as it was preferable to prevent trouble beforehand. The author did not give much information about his sub-station plant, but it seemed likely that the large number of induction motors in use would lower the power factor. On the question of overloading sub-stations, it was advantageous that the plant should take considerable excess loads at the peak.

MR. MARTIN ROBERTS complimented the author on his coal-conveying plant, although it appeared dangerous to use 550-volt live rails on the coaling pier. The arrangement for preventing the runback of a broken conveyor chain had been used for some 12 years in connection with parcel lifts by the Post Office. One little disadvantage of the rotary strainer arrangement was that the strainer did not protect the pump, the latter being outside; if it were inside, however, there would be an inward leakage of warm water.

MR. S. Z. DE FERRANTI said that, looking through the paper, he thought there was a great opening for improved methods of transforming electricity at sub-stations; the other portions of the electrical scheme were already highly efficient. In the thermo-mechanical conversion of the coal into power, they were a long way off perfection, and the problem was to get nearer the efficiency of the electrical end; he still found it necessary to utilise steam engines, despite the improvements in gas and oil engines. Taking the efficiencies given in regard to boiler and engine plant, it appeared that 2 lb. of coal was required per KW. delivered, but actually 3·1 lb. was required, which might be accounted for by stand-by and other losses, and cost, say, £20,000 per annum. But oil engines had no stand-by losses such as these. He agreed with the author as to reliability, but not that it was necessary to sacrifice economy for this; he also considered that less might have been spent on buildings and more possibly on plant if greater efficiency could have been secured.

MR. ROGER SMITH commented on the author's remarks regarding the choice of the Greenwich site in preference to the original one at Camberwell. The author suggested that the latter site would involve an extra charge of 3s. per ton on fuel, but he, the speaker, did not think this was necessarily so, or that the sea-borne coal facilities of Greenwich were of particular value. The latter station could obtain coal from Goole or the Forth suitable for the chain grate stokers in use, and he noted the satisfactory results obtained under contract conditions. But similar fuel could be obtained from the Midlands, say, Nuneaton, the carriage for quantity from the latter place to Camberwell being 6s. per ton. This class of fuel for the Park Royal generating station, when the price was high, cost 7s. 10d. per ton at the pit, and it was, therefore, clear that it could be delivered at Camberwell at 13s. 10d. per ton, and when the price was low at under 11s. 6d. per ton; these figures were practically no more than those obtaining at Greenwich, and, moreover, were for a better class of fuel, as that used at Park Royal had a calorific value of 13,250 B TH.U. as against 12,500 B TH.U. at Greenwich. At Park Royal the coal cost was now 5s. 4½d. per ton in wagon at the pit, and the freight amounted to 5s. 3d. per ton; the cost of delivering from wagon to outside bunker was 1/400d. per ton, inclusive of ash removal as against about 2d. per ton from pier-head to bunker at Greenwich. On the whole question of a riverside site, as compared with an inland site using cooling towers, Mr. Smith quoted the results obtained at Park Royal, with an output of 14 million units from 4,000 KW. of plant, supplying the G.W. Railway Co.'s electrical routes, which gave coal costs of ·195d. per unit generated and ·218d. per unit delivered to sub-station.

MR. C. P. SPARKS considered that the Greenwich station had been put down at a reasonable cost considering the class of work involved; the choice of site was also, in his opinion, a good one. He would have thought that a higher pressure than 6,600 volts would have been adopted, considering the extent of the distribution. He commended the coal purchase clauses adopted by the author, although it appeared that there must be some difficulty in rejecting a cargo of fuel in which the moisture exceeded 13 per cent. by weight, as the fuel would be in the bunker. On the possible economies of the turbines, it appeared to him that coal, labour, oil, repairs, &c., would prove to be determining factors, and that, contrary to a previously-expressed opinion, these machines would be in use long after the engines had disappeared. He thought that the speed of 94 R.P.M. of the Musgrave engines was too high to enable the Corliss gears to last long. He was in agreement with the author as to discarding reverse relays in connection with generators, and commended the automatic earthing of the Greenwich machines. In regard to the diversity factor, did Mr. Rider take the instantaneous or the power demand?

MR. PARTRIDGE agreed with previous remarks on the advisability of omitting reverse-current relays on generators. As regarded the earthing of the generators, in many cases the star points were coupled up solid—he himself had four three-phase machines so coupled, and had experienced no trouble. He considered it a mistake to drive centrifugal pumps by three-phase motors, as falling periodicity meant falling motor speed just when it should be above the normal. In the old days, when the Ferranti converter was used, there was trouble similar to that obtaining with induction-motor windings, and it was overcome by switching in on the L.T. side. He had recently got over difficulties in switching-in 250-KW. motors by using water resistances, and this method was, he thought, standard for the firm which supplied them. With the low periodicity adopted by the author, it appeared that the use of converters would have saved considerable capital expenditure.

MR. ROBT. HAMMOND thought that Mr. Smith had hardly entered into the question of condensing when he compared the Camberwell and Greenwich sites. The weight of opinion was in favour of riverside sites; indeed, among others, he had spent 31 days in proving this before a Parliamentary Committee in recent

times, and he did not think that Mr. Smith would convince anyone that a 30,000-kw. station should be placed at Camberwell.

Mr. E. L. O'Brien (L. & Y. Railway Co.) thought some of the provisions of the coal contract gave too much latitude to the contractor; also that the 25 per cent. of spare boiler capacity at Greenwich was on the high side, involving excessive initial expenditure. At the Formby station he used superheated steam at 510° F., and found it about the limit which the Corliss valve would stand; also no steam separators were used, and as he had never found moisture in the steam, he did not consider these necessary. In regard to generator earthing, he had not been able to find cross currents between his reciprocating sets, but when a 4,000-kw. turbo-generator was in use, he had found as much as 80 amperes flowing; this, however, gave no trouble, and all the generators were coupled solid to an earth bar. He agreed with previous speakers on the matter of discarding time-limit relays on generators; they were generally not in operation so far as he had seen.

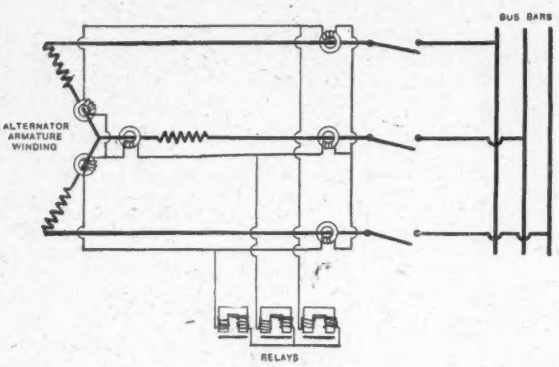


Fig. 1.

Mr. H. W. Clothier agreed with previous speakers that no relays at all were better than reverse-current relays on a generator. But, nevertheless, some protection was necessary; he had known a turbo-alternator to fly to pieces, and such occurrences as this required some sort of instantaneous protection. Such an arrangement was obtainable with the Merz-Price system, as shown in fig. 1. On the matter of switchgear, Mr. Rider's arrangement at Greenwich, which

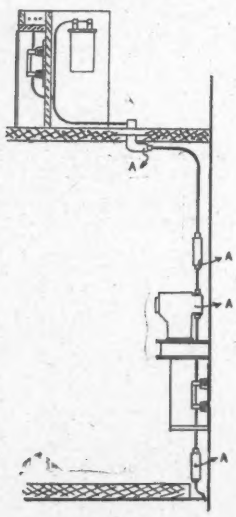


Fig. 2.

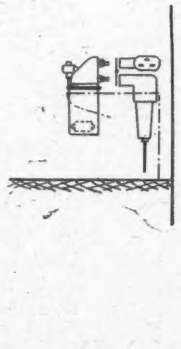


Fig. 3.

included certain ironclad portions, could have been much condensed if it had been made ironclad throughout (on the system adopted by a well-known Tyneside firm). For comparison he sketched the actual and possible switch arrangements, as in figs. 2 and 3.

Mr. J. F. C. Snell considered that the electrical scheme was well thought out and simple, but there were some details on which one might comment. It appeared to him that the h.t. switch cells might have been under the operating gallery in preference to above it, this arrangement showing some saving in cable; 33 per cent. of spare plant in a sub-station with six units also seemed excessive; one unit would have been sufficient. He also thought, although there might be reasons to the contrary, that rotary converters might have been used, with an improvement in efficiency and saving in first cost. The rotary would have given some 10 per cent. greater efficiency, which, on the Greenwich output of 60 million units, meant a saving of some £4,200 per annum. He thought it strange that Glasgow, with its h.t. distribution scheme, only used 1·25 units per car-mile, while the L.C.C. cars appeared to require 2·25 units; the latter were, no doubt, heavier, but this did not account for the difference.

Mr. W. H. Patchell said the extensive use of chain-grate stokers had increased the price of washed nuts in London, and he thought it worth while to adapt a proportion of grates for other classes of fuel. Considering the size of the plant, the boilers seemed of small individual capacity; he had used 100,000-lb. boilers at Bow, and also, on a 5,000-kw. plant he recently carried out, had used larger boilers than at Greenwich. He did not claim any greater thermal efficiency for the large boiler, but it was more convenient to handle and saved space and buildings—an important matter if turbines were to be used. The station appeared to be over-boilered, but the turbines might use up the excess of steam-raising plant. It was not clear whether the water meters were on the suction or delivery side of the pump; this affected both wear and tear and accuracy. The separators also appeared to be unnecessary with the superheat, but he was surprised that the latter had not given trouble with the Corliss valves. The drainage of the big engines was apparently better in the Greenwich engines than in those at Manhattan, but there had been no trouble with the latter. The 3,500-kw. Manhattan engines took 17·05 lb. steam at 150 lb. pressure, with saturated steam; correcting for superheat, this gave 20,300 B.Th.U., as against 20,900 B.Th.U. for the 16·88 lb. of superheated steam in the case of the Greenwich engine tested by Mr. Rider. He noted that the author had not yet settled how to start the induction motor-generators which he used so extensively; he, the speaker, had had no trouble with the synchronous machines used by the Charing Cross Co., and he would certainly use them exclusively if he were to carry out similar work again. As regarded the failure of end coils in the motor-generators, he was not sure whether the trouble was wholly electrical; he thought it might be in part mechanical. A comparison of the cost of sections of the plant showed that the generating station cost was about half the total cost, and that all cable and street work was in addition to this.

Mr. Kenelm Edgcumbe said that, reading between the lines, it appeared that the author's reverse relays had been cutting out generators when they should not have done it. He suggested that the reverse relays were set abnormally low—about 10 per cent. of the machine output was the usual thing, but this was scarcely applicable in the case of a large plant. Possibly a time lag might be introduced, but, in any case, it was very drastic to do away with protection altogether.

Mr. H. M. Sayers agreed with a previous speaker as to the mechanical effect in breaking down end coils, as from measurements made on some of the machines at the moment of switching in, as much as $\frac{3}{8}$ in. circumferential and $\frac{1}{4}$ in. of axial movement had been noted. The author's choice of induction motors had been criticised, but he was not surprised that he had not used rotaries on a system like the conduit, subject to heavy short circuits. He was, however, surprised that motors-converters had not been adopted, as they appeared to him to combine all the good points of the other types of plant. So far as he could judge from the data given, the energy consumption of the L.C.C. cars (2·3 units per car-mile) appeared very heavy, even for the bogie cars used; the amount also appeared to have grown considerably during 1908. Indirectly one could obtain information as to the value of the big station from the paper; taking the operating cost at Greenwich and calculating the cost of transmission to a sub-station 10 miles away, as happened in this case, he found that it would be possible to deliver energy to that sub-station at a cheaper rate from a second power station only five miles away, even with extra fuel charges.

Mr. G. L. Addenbrooke considered that when turbines were employed, it would be possible to do away with excessive blowing off by using distilled water as on board ship.

Mr. J. R. Salter thought that the station might have been placed more centrally and thus have saved in cable cost—he suggested Southwark as a possible site. He did not see the use of such a small battery as that mentioned. The paper contained about six pages on the inherent defects of the conduit system; possibly it was to the latter that the extraordinarily high energy consumption was due. He could not understand the use of shunt-wound machines, but it was possible that they were responsible for the low efficiency of the system, as the line pressure must be subject to more variation than would be the case with compound-wound generators.

Mr. H. Brazil did not think the automatic earthing switch described would be generally advantageous. It appeared complicated and costly, and it left a time interval between the earthing of successive machines; it also seemed to be applicable only to one part of the plant, if the latter were worked in halves. He suggested an arrangement of carbon-powder resistances, one between each neutral point and the earthing bus, and a further one between the latter and earth. Such resistances were high when cold, and would carry a large amount of power, but they automatically decreased in value until the current flowing was sufficient to operate the trips.

Mr. A. D. Clarke (Underground Electric Railways Co.) asked for more information in regard to the earthing resistances. His company had recently designed a new resistance for the Lot's Road station, to carry 5,000-6,000 kw. for 10 minutes, and it was found necessary to provide some 5 or 6 tons of metal. The switch arrangement would necessitate the stoppage of the auxiliary motors if anything went wrong with the one section of the bus-bars from which they were supplied; as regarded condensing plant, this would be a serious matter with turbines. He doubted the boiler efficiency given, suggesting 74 per cent. as a more reasonable figure. From his experience, it was very poor coal that did not reach 13,000 B.Th.U. when dry, and he thought the coal schedule appeared to allow too much latitude to the coal contractor.

Mr. Leonard Andrews, in a communication, made a compari-

son between certain features of the cost of the present Greenwich station and the probable cost of a plant using cooling towers and situated more centrally. He noted that Mr. Rider's actual capital outlay of £23·63 per KW. had passed without comment, although he (Mr. Andrews) was recently criticised for assuming £14 per KW. with cooling towers, on the ground that a river site would have given a lower figure. From a consideration of the cost he concluded that cooling towers would have cost less initially and per annum than the Greenwich pier and river work, exclusive of the elaborate strainers, &c. The original coal and ash handling plant would probably not have cost more than that of Greenwich, plus the cost of strainers. Foundations by a river, no doubt, cost more; a riverside station building recently visited cost £5·44 per KW installed including £3·3 per KW. on foundations. The extra land for cooling towers would cost in ground rent, say, £250 per annum; extra pumping would cost £3,240, and make-up, from a well, £2,340 per annum. Judging by the coal used at Pinkston (3·05 lb. per KW.-hour), with canal water for condensing, there was no advantage at Greenwich under this head; and if an allowance was made for 20 per cent. of the output at Camberwell being direct instead of alternating current, and therefore saving cost in conversion, it appeared that £9,250 could be saved in that way. On the whole, the case was represented by the following balance-sheet:—

Dr.		Cr.	
Pier and river work, £60,000 at 8 per cent.	£4,800	Reduced transport	—
Converting E.H.T. to D.C., 18,200,000 units at ·122d. ..	9,250	Cooling towers, £30,000 at 10 per cent...	£3,000
		Extra ground rent, 5,000 yards at 1s.	250
		Pumping water, 2½ million units at ·34d.	3,240
		Extra make-up water, 28 million gallons at 2d. per 1,000..	2,340
		Reduced coal consumption ..	—
		Debit balance in addition to extra costs of transmission..	5,220
	£14,050		£14,050

It appeared from this that there was little to choose between the original schemes; he, however, considered that the use of large gas engines would have brought the running costs down from £92,000 to £60,000.

Mr. J. H. Rider, owing to shortness of time, reserved his reply for publication in the *Journal*.

Electrically Driven Ring-Spinning Machines with Adjustable Speed.—Messrs. Brown, Boveri & Co., in the course of their experiments on ring-spinning machines, have found that, in the interests of uniformity of quality (equality of tension) and absence of breakage, it is essential that the yarn, on its way to the winding bobbin, should be allowed to fly out in the form of a balloon under the action of the centrifugal force due to its rotation. This balloon forms a sensitive safety device, enabling the danger of breakage from small knots or other irregularities in the yarn, which could not be dealt with by the ordinary tension device, to be successfully overcome. If the machine is run at a uniform number of revolutions per minute, it is clear that the speed at which the yarn is wound will increase steadily as the diameter to which the bobbin has become filled increases. This increase in speed prevents the proper formation of the "balloon," and consequently the constant speed of running has to be reduced so as to suit the highest permissible speed of winding, and the speed during the greater part of the time is then unnecessarily low. The difficulty is sometimes overcome by introducing coned belt pulleys, by means of which the revolutions per minute can be varied by hand as desired, but in modern spinning mills using individual electric driving with direct-current motors, a finely divided shunt-regulating resistance gives the necessary control over the speed. To meet the corresponding case with an alternating current supply, Messrs. Brown, Boveri have introduced a single-phase commutator motor with Deri's connection in which the speed can be readily varied by brush shifting. The stator is wound for 500 volts or more without transformers. The rotor winding is quite separate from the supply and works with low-pressure currents. The operations of starting, speed regulation and stopping are all carried out entirely by brush shifting. At starting the torque developed is several times the normal, and the speed can be increased from zero to a maximum, perfectly uniformly, without the least shock. The speed is varied during the spinning process by means of an automatic brush-shifting device attached to the spinning machine. This device can be fitted to any existing machine.—*E.T.Z.*

Electrical Illumination in Italy.—Some statistics recently published in our contemporary *L'Elettricista*, of Rome, are interesting, showing the enormous development that has taken place in the distribution of electrical energy throughout the country. The number of units on which the Government claimed a tax in 1896-7 was 1,610,670. In 1900-1 this consumption had increased to 32,193,400, and in 1904-5 to 62,156,600. With regard to the distributing centres, the Lombardy Co. has 223 sub-stations, the Piemonte Co. coming next with 188. In 1904 there were 817 central electrical stations, having a total capacity of 196,024 H.P., employing 4,202 workmen. In 1905 the number of stations had sensibly increased, 516 stations being erected for the supply of villages having less than 5,000 inhabitants. It is a matter of regret that more recent figures are not obtainable. As regards imports into Italy, we are as favourably situated, and at least as popular, as any of our rivals, and we ought to cultivate this field.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

COLOMBIA.—The exact net weight and gross weight in kg. should be marked on each package and specified on invoices and bills of lading. The origin of the goods should be declared on all documents. The marks and numbers on the packages must agree with those on the documents. Consular invoices in quadruplicate, in Spanish, should be made out on special forms which may be obtained at the Consulate. Only one mark is allowed on each invoice and a Consular visa is required. The Consular invoice should show the name of vessel, captain, port of departure, port of arrival, name of shipper and name of consignee, and the mark, numbers and contents. The following fees are payable:—Invoices up to £40 value, £3 12s.; invoices more than £41 and up to £100 value, £4 16s.; invoices more than £101 and up to £200 value, £6; invoices over £200 value, the same fees as for fractions thereof. Bills of lading cost 12s. per set and bills of health 12s. per set. The steamship companies through whom shipments are sent usually attend to the Consular formalities. Shippers are liable to heavy fines for any irregularities.

100 centavos = 1 peso = 4s. 2d.

Note.—A surtax of 70 per cent. of the duty payable at the following rates is also charged.

	Centavos per kg.
Caoutchouc, unmanufactured	20
Conduits, pipes and tubes for pumps, drains, roofs, of caoutchouc; caoutchouc prepared for machines and flooring	3
Caoutchouc manufactured into other articles ...	80
Manufactured hides, skins and leather	80
Articles of all kinds, of common faience and stoneware...	5
Ditto, of porcelain and talavera	10
Conduits, pipes and tubes, of earthenware, for pumps, drains and roofs	3
Articles of glass, except mirrors, plate glass, demijohns, &c.	10
Railway sleepers	free
Carriages and trucks for railways	free
Pig iron	1
Rails, spikes, &c., for public or private railways ...	free
Bridges for public roads	free
Bridges for private roads	3
Gasometers, apparatus, conduits and lamps for public lighting	free
Telegraph wire for public use...	free
Ditto, for private use	2
Lightning conductors	free
Galvanised iron in plates and sheets...	1
Hydraulic pumps and machinery with pipes and accessories	3
Machines for mechanical purposes or mining ...	1
„ for arts trades or industries	3
„ for agricultural purposes	2
„ not mentioned elsewhere:	
Weighing not more than 1,000 kg.	3
Weighing more than 1,000 kg.	1
Motors of all kinds and of any power	2
Large boilers	3
Steel in bars or rods for manufacturing purposes ...	2
Iron and steel, manufactured, not specially mentioned in the tariff...	20
Copper or bronze, unwrought, in bars or ingots, plates and sheets	5
Copper or bronze articles weighing more than 25 kg.	10
Ditto, weighing more than 500 grammes and not more than 25 kg.	20
Ditto, weighing less than 500 grammes	30
Lead slabs, pipes and other articles weighing more than 5 kg.	3
Resin, yellow	1
Articles imported on account of the Government, whatever their nature	free
Petroleum and gasoline for motor power	1
Graphite and black-lead	3
Dynamos...	3
Roman cement and hydraulic lime	free
Camel hair belting	40
Traction engines, boilers and trucks for the same ...	free
Materials for electric lighting works in Barranquilla	free

Electrical Exhibition at Brescia.—This Exhibition is to be opened on August 8th. The buildings are already well advanced, and many well-known Continental firms are lending the Committee such assistance as will ensure success. The opening of the Exhibition coincides with an important political anniversary connected with the town.

NEW PATENTS APPLIED FOR, 1909.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

9,178. "Improvements in the mechanical arrangement for securing a quick make and quick break in conjunction with electric switches." T. R. H. Tetley and J. Strachan. April 19th.

9,194. "New or improved means of locking electric incandescent lamps to their holders." E. P. Cottier. April 19th.

9,201. "Improvements in switches for breaking electric circuits." W. C. Kirwan and K. Quaney. April 19th.

9,231. "Improvements in and relating to electro-magnets and solenoids." L. Sunderland and G. C. Pillinger. April 19th.

9,242. "Improvements in or relating to electro-magnetic speed indicators." J. W. Henwood. April 19th.

9,265. "Improvements relating to the manufacture of glow lamps with metallic filaments." Bergmann-Elektricitats-Werke Akt.-Ges. (Date applied for under Sec. 91 of the Act, February 18th, 1909, being date of application in Germany.) April 19th. (Complete.)

9,275. "Improvements in or connected with starting and reversing devices especially, though not exclusively, applicable to electric pulley blocks." Electric Pulley Block Co., Ltd. (A. A. C. Gese, Germany.) April 19th. (Complete.)

9,304. "Automatic limit switch for electric lifts." J. Goddard. April 20th.

9,318. "Improvements in and relating to electric incandescent metal or other filament lamps." S. Horvath. April 20th.

9,322. "Improvements in electric glow lamps." A. J. Holland. April 20th.

9,338. "Improvements in or relating to electric reversing gear." Felten and Guilleaume Lahmeyer-Werke Act.-Ges. (Date applied for under Sec. 91 of the Act, November 30th, 1908, being date of application in Germany.) April 20th. (Complete.)

9,349. "Improvements in and relating to electric controllers." R. V. R. Sill. April 20th. (Complete.)

9,424. "Improvements in electrically-propelled vehicle brakes." J. F. Simpson. April 21st.

9,427. "Improved means for producing phase-displaced electro-magnetic oscillations." M. Monasch. (Date applied for under Sec. 91 of the Act, April 21st, 1908, being date of application in Germany.) April 21st. (Complete.)

9,456. "Improvements in electric switches." G. W. Hawker. April 21st.

9,502. "Improvements in apparatus for periodical interruption of alternating electric current." L. J. B. Drault. (Date applied for under Sec. 91 of the Act, April 23rd, 1908, being date of application in France.) April 21st. (Complete.)

9,516. "Improvements in electric arc lamps." H. P. Bleckly. April 21st. (Complete.)

9,550. "Improved method of retaining the charge in accumulator plates." B. M. Drake, J. Waddell and D.P. Battery Co., Ltd. April 22nd.

9,550. "Improvements in dynamo-electric machines." J. W. Burleigh and J. W. Wardle. April 22nd. (Complete.)

9,592. "Improvements in switch plugs for telephone exchanges." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) April 22nd. (Complete.)

9,623. "Improvements in train controlling means on electric railway systems." W. Robinson. (Date applied for under Rule 13, October 20th, 1908. An invention comprised in application No. 22,227, dated October 20th, 1908.) April 22nd. (Complete.)

9,666. "Improvements in methods of charging and discharging batteries." A. M. Taylor. April 23rd.

9,686. "Improvements in and relating to outgoing telegraph signal recorders." A. W. Sharman. April 23rd.

9,692. "Improvements in storage batteries." C. H. Montgomery, J. H. Young, R. E. Hellyar and R. J. E. Baker, trading as Southsea Motor Engineering Co. (Date applied for under Rule 13, December 22nd, 1908. An invention comprised in application No. 27,882/08, dated December 22nd, 1908.) April 23rd. (Complete.)

9,699. "Improvements in portable electric lamps." H. F. Joel. (Application for Patent of Addition to No. 11,106 of 1908.) April 23rd. (Complete.)

9,700. "Improvements in automatic annunciators." E. Pickel. April 23rd. (Complete.)

9,705. "Improvements in electric fan motors." H. Hirst and A. J. D. Krause. April 23rd.

9,744. "Improvements in electric alarm or signal clocks." B. Thomas and E. Thomas. April 24th.

9,760. "Improvements in electric lamps or lanterns." J. M. Muir and C. H. K. Chamen. April 24th.

9,796. "Improvements in and relating to electrolytic cells." H. W. Bradley and J. R. Williams. April 24th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

Magnetos for Ignition Purposes in Explosion Engines. T. Wardell. 4,329. February 27th.

Switches and Fuses for Starting Three-Phase Electric Motors and the like. V. Hope. 4,597. February 29th.

Electric Incandescent Lamps. C. H. Stearn, C. F. Topham, W. Handcock and R. Dykes. 4,922. March 4th. (Post-dated September 3rd, 1908.)

Alternating-Current Motors of the Commutator Type. British Thomson-Houston Co. (General Electric Co., United States.) 6,959. March 27th.

Electric Accumulators. W. Fennell and W. P. Perry. 6,976. March 30th.

Apparatus for Alternative Wireless Telegraphy and Telephony. J. Schiessler. 7,028. March 30th. (Request under Sec. 19 not granted.)

Electric Meters of the Moving-Coil Type. Evershed & Vignoles, Ltd., and S. Evershed. 7,298. April 3rd.

Switches for Electrical Purposes. T. J. Rorke and E. Rorke. 7,469. April 3rd.

Electrically-Heated Tools. J. Certly and C. F. Dudley. 7,507. April 4th. (Date applied for under International Convention, April 6th, 1907.)

Electrical Arc Lamp Lens and Screen for Theatrical Stage Effects. G. A. Applebee. 8,353. April 14th.

Electric Arc Lamps. W. J. Davy. 8,009. April 14th. (Cognate application 9,962/08.)

Devices for Controlling Electric Circuits. P. T. McNally. 8,748. April 21st.

Automatic Electric Lifts. C. G. Major, E. C. Stevens and P. H. Stevens. 9,195. April 28th.

Electromagnets. M. Kotyra. 9,291. April 29th.

Electric Furnaces. E. Cornelius. 10,378. May 13th.

Electric Light Fittings for Railway and like Carriages. F. J. B. Collis, W. H. Exley and T. Leitner. 10,712. May 16th.

Method of and Apparatus for Automatic Regulation of Rectifiers and Rotary Converters. F. B. Crocker. 10,793. May 18th.

Electrical Power Transmission Systems. British Thomson-Houston Co. and W. F. Dawson. 11,344. May 25th.

Means for Igniting Carriage Gas Lamps by Means of Induced Current. C. Heinrichdorff. 11,586. May 28th.

Electric Circuit Controllers for Railway Signals and the like. S. P. Wood. 11,986. June 2nd.

Automatic Apparatus for Controlling the Speed of Trains and like Vehicles. A. J. Boult. (Union Switch and Signal Co.) 12,177. June 4th.

Electricity Meters. Isaria-Zahlerwerke Ges. 12,250. June 5th. (Date applied for under International Convention, May 11th, 1908.)

Suspension Devices for Electric Cables. W. T. Henley's Telegraph Work Co. and W. F. Bishop. 13,654. June 27th.

Squirrel-Cage Rotors for Induction Motors and Alternators. J. C. B. Ingleby. 13,719. June 29th.

Refining of Steel in Electric Furnaces. R. Perry. (Co. Bismarkhütte.) 14,926. July 14th. (Request under Sec. 19 not granted.)

Electric Capstans. Sir W. G. Armstrong, Whitworth & Co. and R. Wright. 15,071. July 22nd.

Telephone Transmitters. W. Aitken. 15,615. July 29rd.

Apparatus for Testing Magnetic Qualities of Metal. British Thomson-Houston Co. and A. J. Martin. 15,941. July 27th.

Disinfectant Telephone Transmitter. H. R. Soar. 17,475. August 20th.

Cylindrical Positive Electrodes. A. J. Boult. (Allgemeine Akkumulatoren-Fabrik.) 17,750. August 24th.

Electric Circuit Tester. W. Roos. 18,359. September 1st.

Ignition System for Explosion Engines. R. Varley. 19,349. September 22nd.

Electrical Potential Regulators or Speed-Controlling Devices. Siemens Bros. Dynamo Works. (Siemens Schuckertwerke Ges.) 21,913. October 16th. (Application for Patent of Addition to No. 14,723/07.)

Electric Fusible Cut-Outs. T. E. Murray. 24,702. November 17th.

Coupling for Electric Cables, Wires and Rods. F. Westcott and F. Garside. 28,102. December 24th.

1909.

Electric Contact Making and Breaking Device. M. Peaucellier. 3,521. February 13th. (Date applied for under International Convention, May 4th, 1908.)

Apparatus for Wireless Telephony. J. Schiessler. 4,026. February 18th. (Date applied for under Rule 13, March 30th, 1908.)

Wireless Telephony. J. Schiessler. 4,027. February 18th. (Date applied for under Rule 13, March 30th, 1908.)

Production of Metallic Articles by Electro-Deposition and the Articles so Produced. F. I. Gibbs. 5,958. March 12th. (Date applied for under Rule 13, February 27th, 1908.)

Metal Vessels Produced by Electro-Deposition. F. I. Gibbs. 5,959. March 12th. (Date applied for under Rule 13, February 27th, 1908.)

Processes for Producing Metallic Articles by Electro-Deposition and the Articles so Produced. F. I. Gibbs. 5,960. March 12th. (Date applied for under Rule 13, February 27th, 1908.)

Models for Use in the Formation of Metal Vessels by Electro-Deposition. F. I. Gibbs. 5,961. March 12th. (Date applied for under Rule 13, February 27th, 1908.)

Processes for Producing Metallic Articles by Electro-Deposition and the Articles so Produced. F. I. Gibbs. 5,962. March 12th. (Date applied for under Rule 13, February 27th, 1908.)

Combined Tramway and Telegraph Pole. J. Hackett. 6,004. March 12th (Date applied for under International Convention, August 14th, 1908.)

Central Station v. Isolated Plant.—A somewhat interesting comparison of production costs of certain American public and private electrical plants is contained in an article in a recent issue of the *Electrical Age*, which utilises certain data from the *Engineering Magazine*. From this it appears that six public plants, averaging over 6,000 H.P. of plant each, and with an output on the average of nearly 6½ million units each per annum, operated with station costs (for fuel, water, stores, wages, repairs, &c.) varying from 1·06 to 1·62 cents per KW.-hour. The isolated plants, also six in number, gave the following results:—

	H.P. of plant.	KW.-hours per annum.	Operating cost, cents per KW.-hr.
Bank	1,500	1,546,000	·583
Hotel	250	115,000	1·061
Store	350	287,100	·506
Apartment house ...	300	232,960	·524
Club	225	93,800	·596
Factory	1,500	2,125,600	·545

It will be seen that even at the switchboard the private plants operate, on the average, much more cheaply than the public ones, despite the great difference in capacity and output; and when distribution costs are added, the difference must be even more pronounced. It is conceded that the private plants have the better load factor, but, considering the difference in outputs, this hardly explains the fact that fuel costs the public stations approximately ·7 cent per KW.-hour, as against an average of ·4 cent in the case of the private plants. Our contemporary promises to investigate the distribution charges in the two cases, and we would suggest that if capital costs, rent, rates, taxes, management, &c., could be added, so as to give a true commercial cost comparison, the results would be of considerable interest.

Belgium.—The report of the Société de l'Electricité du Pays de Liége for the last financial year shows a profit of £4,894. A dividend of 5 per cent. is being declared, the same as for the preceding year.